

IMPROVING THE ENVIRONMENT THROUGH REDUCING SUBSIDIES

Part I Summary and Policy Conclusions



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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Publié en français sous le titre :

RÉDUIRE LES SUBVENTIONS POUR AMÉLIORER L'ENVIRONNEMENT

Partie 1 : Résumé et conclusions

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FOREWORD

OECD Environment Ministers in February 1996 supported the 1995 request by G-7 Ministers of the Environment that the OECD undertake "a wide-ranging study of the effects of subsidies and tax disincentives to sound environmental practices in various economic sectors and the costs and benefits of their elimination or reform". This led the OECD Council at Ministerial level on 21 and 22 May, 1996 to request an "analysis of the elimination or reform of environmentally-harmful subsidies". This publication summarises and provides the policy conclusions of the report on *Improving the Environment through Reducing Subsidies*, which was undertaken in response to both mandates. The second part of the report gives a fuller exposition of the case studies used and the analysis developed.

This report draws heavily on the results of a number of recent OECD studies, as well as on the OECD's ongoing and previous work on the environmental effects of support to various sectors, including agriculture, energy, transport and industry. The report primarily collects and synthesises the available work on support measures and their environmental effects to present an overall picture of the costs and benefits of support reform or removal. In addition, a few new case studies have been undertaken in order to fill in some of the gaps in the available literature.

The work on this project was overseen by five Ad hoc Meetings of Experts on Subsidies and Environment, which brought together both environmental and fiscal specialists. The report is published on the responsibility of the OECD Member Countries.

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1. INTRODUCTION

Support removal might lead to significant improvements in environmental quality

This report examines the effects of removing only those types of support measures that are harmful to the environment

Will the environment benefit from support removal?

The environmental effects of economic support to energy, agriculture and transport have attracted considerable scientific and political interest since the mid-1980s. Support removal has been identified as a potential ‘win-win’ policy in that it may benefit both the economy and the environment. Yet, despite national and international pressures to reduce subsidies, levels of support remain high in many OECD Member countries. Given the volumes of pollution and waste associated with many of the supported activities, a reduction in support levels could lead to environmental benefits in addition to the economic gains from reduced government outlays and improved economic efficiency. Because of this potential for win-win gains through reducing support, the OECD Council requested at its Ministerial Level meeting on 21-22 May 1996 that a wide-ranging study be undertaken on the costs and benefits of removing environmentally-harmful support measures.

Economic support measures come in a wide variety of forms, including direct and indirect support payments, tax expenditures through tax concessions to specific industries or regions, market price support and other regulations that enhance the competitive position of particular industries or sectors. Therefore, this study takes a broad perspective in examining the benefits and costs of reforming or removing

all kinds of financial supports and regulations that are put in place to enhance the competitiveness of certain products, processes or regions, and that, together with the prevailing taxation regime, (unintentionally) discriminate against sound environmental practices.

Not all support measures will necessarily have a detrimental effect¹ on the environment. However, according to the

¹ Detrimental/ negative/ or adverse effects on the environment as discussed in this study refers to those levels of waste and emissions, including those of the previous and subsequent stages of production and consumption, that are generated because a support measure is in place and which would not occur if no support was applied. Of course, whether such effects will be deemed politically relevant will depend both on the local environmental conditions and the prevailing political perceptions.

The non-internalisation of external costs can have significant effects on the environment ...

mandate, this report examines the costs and benefits of removing only those support measures which have a *negative effect* on the environment — thus the report does not examine the effects of removing any support measures which benefit the environment.

The non-internalisation of the full environmental and social costs of economic activities takes place in all sectors of the economy, and it is sometimes referred to as an ‘implicit subsidy’. The non-internalisation of these external costs means that some of the damage caused by these activities is not paid for by those undertaking the activities. These implicit transfers, from those who suffer from the social and environmental damage to those who produce it (but do not pay for it) are often significant. Considerable research has already been undertaken, particularly through the OECD ‘green’ tax reform programme, into the implementation of economic policies for internalising these costs and ‘getting the prices right’.

... and raises the question of whether the prices of some goods and services are ‘right’

As a result, and because of the complexities involved in examining such effects and because they are not direct support mechanisms, this report does not generally analyse these market failures. Instead, support removal is viewed here as one step towards the full cost pricing of environmentally-harmful activities. As such, it is not a substitute for but a *complement to* policies which internalise the social and environmental costs of these activities. It is the combination of support removal and the introduction of economic instruments to internalise the external costs of economic activities that will result in ‘getting the prices right’, and thus optimising the economic system.

Whether a particular support measure will harm the environment or not will depend on a number of factors

Even within the subcategory of those support measures that may have environmentally-harmful effects, there is no straightforward link between the size or type of support, or the nature of the recipient sector, and the environmental damage. Instead, the environmental effects of a support measure will depend on a number of characteristics, both of the support itself and the

- *relevant input and final product markets,*
- *substitute technologies, products or services available with more favourable environmental profiles,*
- *prevailing taxation regime,*

- *regulatory and institutional framework, and the*
- *local bio-physical characteristics of the recipient environment.*

It is only once all of these factors are considered that both the potential negative effects of the support on the environment and the effects of the support on the intended recipient sector can be understood.

The benefits of support removal often outweigh the costs ...

This report draws on the results of a number of case studies to examine the predominant support policies in place in OECD Member countries and, where possible, how the characteristics outlined above work with the support measures to determine the potential environmental and economic effects of their removal. Many support measures are used to promote growth, employment and increased incomes in a particular sector. However, the case studies indicate that they are often ineffective in achieving these objectives, especially when they are used to prop up ailing industries, as is frequently the case. Even when they are ineffective in this respect, they may still contribute significantly to potential environmental damage. In such cases, the benefits of support removal will clearly outweigh the costs. In particular, those support measures that are tied to the use of certain technologies, levels of input use or production levels will be amongst the most damaging to the environment.

... especially if all benefits and costs are properly considered ...

It is also important to examine the reasons why the support was originally levied. In some circumstances, support measures may be the best available tool for achieving a particular policy objective. If they have environmentally-damaging effects, removing them may necessitate a trade-off between environmental and other objectives.

Many support measures that adversely affect the environment were implemented, sometimes decades ago, to benefit particular sectors or regions. Often they are no longer effective at achieving their original aims, or these aims are no longer relevant or desirable. This is particularly true when the effects of these supports on government budgets or the economy as a whole are considered, rather than just their effects on the particular sector or region that is supported.

***... and adequate
strategies to remove the
support are developed***

As removing support measures can cause hardships to some groups, it is imperative to consider all the costs and benefits when considering their removal. Policy makers can then devise appropriate implementation policies, such as measures to facilitate the transition of the supported industry or employees into more profitable alternatives. To do so may require the replacement of the support by (preferably temporary) compensatory payments. It is important that any transitional payments used are decoupled from production levels, environmentally-damaging production processes and input usage, so that negative environmental effects can be reduced during the period of economic restructuring. Increasing the transparency of support measures can lead to a better understanding of who benefits and who loses from the policies, and by how much.

2. TRENDS AND CURRENT LEVELS OF SUPPORT

2.1 Levels of support in OECD Member countries

Support to agriculture, energy and industry has been decreasing in recent years ...

What data are available on support levels indicates that overall they are declining, but slowly. Other than for agriculture and coal production, however, internationally comparable data on support levels is either scarce (such as for industry and other forms of energy) or almost non-existent (such as for transport and fisheries). Support to agriculture makes up the bulk of the quantified support in OECD Member countries, and total transfers associated with agricultural policies accounted for almost US\$ 300 billion in 1996. This amounted to 1.3% of GDP, and represented a decrease from an estimated 2.2% in 1986-88. Support to agricultural producers also fell, from 45% in 1986-88 to 36% in 1996 as measured by the percentage producer subsidy equivalent (PSE). However, these decreases in total agricultural support need to be considered with some caution. The majority have taken place only recently and have largely been the result of rapid GDP growth and high world prices which have narrowed the support gap between domestic and world prices, rather than from deliberate policy reforms.

... but levels still remain high, and are even increasing in some sectors and countries

Support to energy probably constitutes the second most significant area of support in OECD Member countries, and the available indicators also show decreases in this support. For example, support to coal producers in a selection of OECD Member countries has declined substantially from almost US\$ 16.5 billion in 1989 to just over US\$ 8 billion in 1995.

Support to OECD industries also fell in the early 1990s, from a peak of US\$ 54.2 billion in 1991 to US\$ 49.3 billion in 1993. However, this trend followed a period of steeply increasing support between 1989 and 1991, and there are no clear indicators of the trend in industry support levels since 1993.

Although aggregate support levels in OECD Member countries have generally been decreasing for all the sectors analysed, this trend can not be seen in all Member countries

and current levels of support continue to be high. Despite considerable international pressure for the reduction of support levels, a number of individual countries are increasing total support levels, sometimes quite substantially and with no indication of an intention to reverse this process. In addition, levels of total existing support vary considerably between Member countries with, for example, three OECD Member countries estimated to be maintaining PSEs to agriculture of under 10% of total production value in 1996, while three others had agricultural PSEs that amounted to over 70% of total production value.²

² As with all quantitative measures of support, the limitations of the available data and methodological difficulties should be considered and caution exercised both in the interpretation of the measures and their use in cross-country comparisons.

Table 1. Developments in selected support levels and in selected countries

<i>Support to</i>	<i>1986-1988^a</i>	<i>1989</i>	<i>1991</i>	<i>1993</i>	<i>1995</i>	<i>1996</i>	<i>Remarks</i>
Agriculture							
Total transfers	279 253	264 239	332 269	337 287	333 255	297 234	US\$ billion ECU billion
Total transfers as % GDP	2.2	1.8	2.0	1.9	1.5	1.3	
Percentage PSE ^b	45	37	42	42	40	36	
Coal production	13.2	16.4	10.3	8.0	8.1	6.7 ^p	Total PSE ^b in Germany, UK, Spain, Belgium and Japan (US\$ billion)
Industry^c		39.0	54.2	49.3			Reported net government expenditures in OECD Member countries (US\$ billion)

p - preliminary

a. 1987 for coal production statistics.

b. Producer subsidy equivalent: a measure of the value of the monetary transfers to producers resulting from policies in a given year, including transfers from both consumers and taxpayers. The percentage PSE is the gross total PSE expressed as a percentage of the value of production.

c. The estimates of support to industry may overlap to some extent with other support estimates, e.g., to energy.

Regulatory reform in the energy and transport sectors has improved market orientation

Regulatory reform that enhances the quality of regulations while increasing their market orientation can complement financial support reductions by increasing competition, particularly with respect to energy and transport markets. If financial support reductions are undertaken without the accompaniment of regulatory reforms, their effectiveness will generally be reduced. So long as other protectionist policies are maintained, government financial support to producers may simply be replaced by increased prices to consumers, thus entailing an increase in the transfer of support from consumers to producers.

In recent years, a number of Member countries have undertaken comprehensive liberalisation of their energy and transport markets with the intention of reducing government financial support and increasing the efficiency of these sectors by making them more responsive to market signals. Thus, several OECD Member countries are liberalising electricity and gas markets, with electricity deregulation generally moving ahead faster than gas. The deregulation of gas markets is quite advanced in some countries, particularly Canada, while the pace of privatisation and deregulation in the European Union has been much slower, with the notable exception of the United Kingdom.

The comprehensiveness of regulatory reform is crucial

Regulatory reform of transport markets in various countries has also had a significant effect on the relative competitiveness and quality of the different modes of transport. The United States undertook a comprehensive programme of transport deregulation starting in the late 1970s, with air, road and rail markets all liberalised at more or less the same time. As a result, all modes were simultaneously given strong incentives to increase efficiency. Through improved energy efficiency and the development of innovative long-distance systems, rail freight transport managed to regain its pre-liberalisation market share after an initial decline. In contrast, road haulage was deregulated in Europe first, leading to a highly competitive road freight industry, while rail deregulation continues to lag behind. Thus, rail freight in Europe has not had the same incentives to increase economic efficiency and, partly for this reason, it continues to lose market share to road haulage.

2.2 Changes in the composition of support

The composition of support is becoming potentially less harmful for the environment ...

Support to agricultural production has been moving away from market price support and other support measures coupled to input and output levels and towards direct income support. Support which is decoupled from production and input decisions in this way does not have the same built-in incentives to expand production and input use (with their associated levels of environmental damage), although it still manages to maintain farm income levels. The composition and levels of support also vary widely by country and by commodity. For example, although the overall trend towards decoupled support is positive, some countries have increased total support to some products, such as beef and veal, with their associated negative environmental effects.

The shares of research and development support that are allocated to various energy sources and conservation is also changing in a more environmentally-conscious direction, although rather slowly. Thus, the share of energy research and development support in OECD Member countries that was allocated to energy conservation rose from 6% to 10% between 1983 and 1994, while for renewable energy sources it increased marginally from 8% to 9%. Similarly, of all the support given to industry in OECD Member countries, the share allocated to research and development, energy efficiency and environmental programmes increased from 18% in 1989 to 21.2% in 1993.

... but it remains predominantly directed to less sound environmental practices and continues to stimulate higher levels of pollution and resource use

Nevertheless, the majority of support to *agriculture* and coal in OECD Member countries continues to be in the form of 'coupled' support measures, stimulating excessive levels of production and input use. Thus, market price support and support to inputs constituted over 60% of total agricultural producer support in Member countries in 1996. In *transport*, support exists in the form of the provision of transportation infrastructure, maintenance and services at prices below long run marginal cost (i.e., where appropriate cost coverage is not achieved) and implicit support through the non-internalisation of the external costs of transport use. Relatively low effective tax rates seem to exist for all modes of freight transport, but primarily for rail, air and perhaps

marine-based transport. Support to *energy* continues to focus predominantly on nuclear and fossil fuels, which accounted for an estimated 75% of total European Union energy support between 1990 and 1995, with the remaining 25% allocated to renewables. Although the share of energy research and development support in OECD Member countries that goes to renewables and energy conservation has been increasing, the share allocated to nuclear and fossil fuels still amounted to 51% and 14% respectively of total funding in 1994.

2.3 Environmental benefits of reducing support

By reducing the market prices of goods (especially materials and energy) or by increasing the revenues of the industries that provide them, the support measures discussed above stimulate high levels of resource use and wasteful production processes, making materials and energy saving less profitable. Therefore, any support measure that lowers the user costs of resource consumption, rather than encouraging a reduced or more efficient use of the resource, will contribute to potentially higher volumes of inputs, throughput and, consequently, pollution. These effects will then need to be countered, often at additional cost, through stricter environmental policies. Thus, reducing a support that encourages the increased intake of materials and energy is likely to also reduce the costs of environmental policy implementation.

Environmentally-damaging support measures also lead to higher environmental policy costs

3. EFFECTS OF DIFFERENT TYPES OF SUPPORT ON THE RELEVANT SECTORS

3.1 Scope of the study

It is the net effect of taxes and subsidies that matters

This report draws together ‘subsidies and tax disincentives to sound environmental practices’ because the behaviour of the recipient sector will not depend on subsidies or taxes separately, but on their *net effect*. The net effect of subsidies and taxes on relative prices will determine the behavioural response of the recipient sector to the support. This response may include changes in the volume and composition of production and consumption, and thus influence the environmental effects of the supported activity. The net incentive a subsidy will create will, therefore, also depend on the prevailing taxation regime.³ The imposition of a subsidy will, moreover, often necessitate an increase in the amount of taxes levied on other sectors in order to finance the support expenditures.

How support impacts on the environment

Three linkages between support and its ultimate effect on the environment

The effects of support on the environment is not determined solely by the effects on the levels and composition of output. Instead, there are three main linkages between support measures and their ultimate environmental effects (see Figure 1 below). *Linkage 1* is the link between the support measure and the volume and composition of output it encourages in the economy. Support implies a transfer from one or more sectors of society to another (for example, from taxpayers to producers or from consumers to producers). This will inevitably lead to changes in the level and composition of output demanded. However, the level and composition of output is already in a state of flux due to other technological and economic developments (the

³ A wider interpretation of the mandate might have included studying the effects of different tax rates for capital, products and labour on the adoption of sound environmental practices. However, because previous studies have reviewed the effects of a budgetary-neutral increase in energy taxes and a decrease in labour taxes on both the environment and the economy, this work is not repeated here.

‘autonomous changes’ indicated in Figure 1) that have nothing to do with the support itself. Analytically, this poses a difficult disentangling problem for any examination of the environmental effects of support. Indeed, considerable variations were found in the results of the case studies reviewed because of the different ways the studies addressed this disentangling problem.

Any changes in the level and composition of output that result from the support will be accompanied by lower or higher levels of potential emissions or waste. What changes will be experienced in actual pollution levels will depend on how much is ‘filtered out’ by environmental policy (with its associated costs). The impact of the changes in the level and composition of output on actual pollution and waste levels constitutes *linkage 2*. The damage done to the environment by the resulting changes in pollution and waste levels will depend on the assimilative capacity of the affected environment, which constitutes *linkage 3*.

The first step towards assessing all the costs and benefits of support removal is to analyse linkage 1

If one is to establish the environmental effects of support measures, as well as the employment, income and growth effects, the first step is to thoroughly analyse the first linkage. While this first step can give some indication of the direction and general magnitude of the potential environmental effects of support removal, linkages 2 and 3 would also need to be thoroughly analysed in order to fully determine these effects. Again, although an examination of linkage 1 can indicate some of the potential effects of support or support removal on employment, income and growth as well, a full analysis of the effects would also require the evaluation of parallel linkages in those areas, such as the interaction of the support measure with other elements of government policy and the desirability of these outcomes given the particular socio-economic circumstances in place.

Because of the complexity and data requirement difficulties associated with establishing linkages 2 and 3, this report primarily examines linkage 1, then draws some general conclusions regarding the effects of linkages 2 and 3.

examination of some of the key characteristics of the support measure, and the markets it operates on, can often indicate the direction and general magnitude of the economic and potential environmental effects.

3.2 A classification of support measures

Given the focus of this study, support measures can be classified according to the conditions on which they are based and their immediate effects on government budgets (See Table 2). Both distinctions are of great importance when deriving the characteristics that may indicate that a reduction in support could result in less government spending while also improving the environment.

Classification of support according to the budgetary impact and the conditions of the support

The immediate *budgetary impact* is a characteristic of the support measure that is obviously of interest in an analysis of the benefits and costs of support removal. Many support measures — such as direct grants, infrastructure provision and tax concessions — are financed directly by government, so their removal will have a positive and immediate impact on government budgets. The removal of off-budget support can also benefit the budget, but in the longer term. It will generally lead to an increase in efficiency within the economy, which can have a positive effect on reducing budget deficits.

The *conditions of the support / points of impact* are also key factors in the determination of the economic growth, employment, and equity effects of the support, as well as its environmental effects. But other factors, such as other government policies and autonomous technical and economic changes, will reinforce or counteract the effects of the support. Indeed, differences in the normal tax rates in any jurisdiction — including the statutory tax rates on labour, capital and profits — can significantly affect the mix of factor inputs used in production, and thus the environmental effects of the economic activities.

Table 2. Classification of principal support measures by budgetary effects and points of impact

Points of impact / support conditionality	Effects on government budgets	
	On-budget	Off-budget ^a
Outputs	• Deficiency payments • Sales premiums • Preferential sales tax and VAT rates	• Market price support - Border protection (tariffs, quantitative import controls) - Market access restrictions - Government brokered sales contracts
Raw material and intermediate product inputs	• Support to material and energy input (e.g., energy, fertilisers, irrigation water) • Provision of infrastructure below long run marginal cost	• Materials and services in kind
Capital and labour inputs or income or profit earnings	• Support to non-material and non-energy inputs (e.g., labour, capital equipment) • Accelerated depreciation allowances (if selective) • Income tax concessions (if selective) • Concessional credit • Debt write off • Support to research and development (e.g., on production techniques, safety or environmental protection)	• Concessional credit • Royalty concessions • Low rate of return requirements • Exemptions from environmental standards • Allowing insufficient provision for future environmental liabilities

a. The off-budget forms of support may have second order effects on the budget. Increased efficiency of the economy as a whole, which will generally result from lower support levels, may increase revenues without increasing the tax burden as a percentage of GDP. Off-budget support measures are also often part of larger integrated support policies, and so are often accompanied by other support measures which do have direct budgetary effects.

To investigate the costs and benefits of support reduction — in terms of employment, growth, income, and the environment — it is useful to start at the industry level and to distinguish between the input markets, the potential alternative production technologies available, and the product (output) markets.

Support that increases the revenue of a sector

For example: regulations which stipulate minimum prices (market price support), and accompanying measures which ensure guaranteed minimum sales levels

Incidence analysis shows that not all market price support reaches the intended recipient sector...

Market price support measures guarantee a minimum price level for the producer above the market price and provide accompanying regulations to ensure guaranteed sales of a certain level of production in excess of demand. They allow the producer to increase his income by increasing the level of profitable production. In order to sell more, more has to be produced, and more inputs will be required to meet this increase in production. As a result, some of the total amount of support will be spent on these inputs, 'leaking' away to the input suppliers rather than staying with the intended recipient. This leakage effect can be substantial. For example, incidence analysis indicates that as little as only one-quarter of the total support given through agricultural price support may reach the intended recipient (the farmer).

The increased demand for inputs to the agricultural process may also push the price of the inputs up. This will both increase the leakage effect of the support and adversely affect other users of the input, who will face the increased prices as well. Where the political objective of the support is to maintain income levels in the intended recipient sector, as with most agricultural support in OECD Member countries, regulations which stipulate minimum prices are clearly a very cost-inefficient, and perhaps even ineffective, means of achieving this objective.

... while downstream industries and consumers pay higher prices ...

Minimum price regulations and accompanying measures will result in an increase in the product price for the downstream market, i.e., a price increase of the inputs to the next stages of production. This may decrease the competitiveness of these downstream activities and can lead to differential pricing, cross-subsidisation (especially from sectors producing for the domestic market to sectors that compete on world markets), and perhaps even to the implementation of measures to support these downstream industries. Although the downstream industries face a higher price for their inputs, total demand for the supported product will not be reduced because accompanying

... and other sectors of the economy also suffer negative dynamic effects as a result of the support

measures are often introduced with the support to ensure certain guaranteed levels of sales.

The total effects of market price support on growth, employment, income and environmental degradation in the recipient sector will depend on the mechanisms briefly sketched above. The support, however, must be financed by some other sector(s) in the economy as a whole, reducing the economic opportunities in those sector(s). Moreover, support which is conditional on output levels tends to lock-in the technological trajectories of the particular products supported. Thus, if a producer is guaranteed a minimum price and quantity sold for a particular product, they will be less likely to consider new, unsupported products or processes that might, if the support were not available, prove more cost-effective.

Similarly, if there are minimum purchase agreements with downstream consumers — such as have been brokered by a number of governments for the purchase of domestic coal by electricity generators — these downstream industries will not have the flexibility to switch to other, potentially cheaper and less environmentally-damaging, inputs. In the long run, this may be detrimental to the competitiveness of the downstream sectors or even the overall economy, as well as harming the environment.

Support that lowers the costs of production

For example: support to inputs, lump sum support to capital, tax exemptions conditional on inputs, low(er) excise duties on fuels, etc.

The levels of support leakage and environmental damage will depend on the elasticities of supply and demand and the input shares

Support measures that lower the costs faced by producers will work differently from those that increase their marginal revenues. For example, with support to inputs, the relative elasticities of demand and supply for the supported input will determine the amount of support that is leaked to the upstream input supplier and the amount that accrues to the intended recipient, the producer. If the producer has a relatively low demand elasticity (i.e., will not readily change the quantity of input used in the process in response to a change in the input price), the input supplier can raise the prices of the input and capture a larger proportion of the support. The larger the elasticities for both demand and

supply of the input (i.e., the more responsive demand and supply are to changes in the price of the input), the larger the volume of input used for a given level of support will be, and thus the larger the associated environmental damage from use of the input.

The effects on the downstream market will be parallel to those in the upstream market. The support that reaches the producer (i.e., what has not already been leaked to the upstream input suppliers) will reduce production costs and allow the producer to lower the prices offered to the downstream consumers. The extent to which the support is translated into reduced product prices (i.e., how much of the support is now leaked to the consumers) will depend on the relative market bargaining powers (the elasticities of demand and supply) of the producer and the consumers. Any reduced prices will, in turn, stimulate demand for the product. The increases in production that result from the support will increase the environmental damage associated with the production process.

Both the input and the output markets are dependent on the technological processes the producer uses. These will determine the producer's elasticity of demand for the input and their elasticity of supply for the product. Of course, if a particular input is supported, the producer will try to use production processes that use higher proportions of this input relative to unsupported inputs. Such support policies can again lock-in particular technological processes, rather than encouraging the development of more efficient, and perhaps less environmentally-damaging, alternatives.

Support that is not conditional on production or input levels

For example: direct income support

Support that is not linked to inputs or production will have less leakage and environmental effects

Of course, if there are no direct links between the support given and the production or input levels used, the support will not directly encourage extra production or input use. It will also not 'lock-in' the use of particular production technologies, or the production of specific commodities, to the same extent. Because such support has no direct effect on the input or output markets, there will be little or no upstream or downstream leakage effects, and a greater

proportion of the support that is given will accrue to the intended recipient sector than for other support mechanisms. In addition, because the support is not dependent on increased production or consumption levels, it will also generally not increase the environmental damage associated with these activities. In sectors where income tends to correlate to employment levels (such as for agriculture), a positive effect on employment may be expected from such support. The increase in profitability experienced by the recipient sector will, of course, *indirectly* have some effect on production and consumption decisions. However, because the support is not conditional on specific output or input levels or particular practices, its effects will still be less detrimental for the environment than other support mechanisms.

3.3 Conclusions

Support can be detrimental for the environment, while only slightly benefiting the intended recipient

The effectiveness of many support measures in benefiting the intended recipients is often very low because of high rates of support leakage to upstream and downstream industries (low transfer efficiency). At the same time, if the support is conditional on the levels of input use or production, it may still have large negative effects on the amount of resources used and the pollution and waste generated. After all, in order to receive the support, even if it is small in net terms because of leakage effects, the recipient will still be required to undertake the conditions on which the support is based, and it is these transactions that result in the environmental damage. For example, because of the relatively high input intensity in agriculture, much of the market price support is likely to leak away to upstream input producers. But the potential environmental effects are dependent on the total input and production levels, which will still increase, not on the effect of the support on farmers' incomes. This asymmetry may be larger in the case of support to input use. Support to inputs will lead to higher levels of input use, and much of the support may leak away to the input supplier through increased input prices.

A quick scan of support measures can be used to prioritise which are most worthy of removal

To identify those support measures that are *likely* to have the largest potentially adverse effects on the environment, one should focus on examining the input and output markets of those sectors that generate the largest volumes of the most polluting emissions and waste, as well as enjoying substantial levels of support. The relevant data needed to perform a quick scan of support measures that are most worthy of further scrutiny includes:

- the *elasticities of demand and supply* on both the input and output markets, which determine the magnitude of volume responses to price changes and the proportion of the support that leaks away to other sectors;
- the *point of impact* (conditions of the support) which, together with the *amount of support*, determines its relative share in (marginal) cost or revenues; and
- the *upstream and downstream environmental effects* associated with the substance flows through the economy that are generated by the support.

Such a quick scan⁴ should be complemented by an analysis of the effects of support removal on equity and the incomes of the intended beneficiaries of the support. The possibility of temporary compensatory measures to balance any income losses should be examined. If they are to be introduced, such compensatory measures should not be tied to production levels, nor to the particular practices or inputs used.

Such an analysis will improve the understanding of the mechanisms at work and their possible impacts, but it will not be able to fully predict the effects of support removal. Because the technological, organisational, and institutional changes in response to support removal are difficult to predict, especially in the long run, it is questionable to what extent detailed case studies will yield more reliable results than the quick scan.

All changes (due to a support measure) that influence the relative costs or revenues associated with the use of certain inputs tend to lock-in particular technologies. If support is

⁴ This ‘quick scan’ is described in more detail in *Improving the Environment through Reducing Subsidies, Part II: Analysis and Overview of Studies*.

***Support to inputs or
production processes
can lock-in
environmentally-
damaging technologies***

tied to particular inputs, the producer will try to increase the relative share of this input in the production process. This also holds true for support conditional on certain practices or processes. Since many environmental improvements are strongly dependent on technological change, such tying of support can block developments that are crucial for achieving environmental objectives. This can be especially detrimental for progress in the reduction of emissions from non-point sources, which must be addressed primarily using measures that influence the levels of resource use.

The removal of a support measure will have the largest beneficial effects on the environment if the current support levels significantly reduce the marginal costs of production, if the production process is relatively highly polluting (or is complementary to other highly polluting practices), and if the support locked-in the use of particularly harmful processes or inputs, thereby stifling technological development.

4. EFFECTS ON INTERNATIONAL TRADE AND COMPETITIVENESS

Support is seldom justified and generally deters international trade, ...

Market price support measures and support to input use may distort trade. With market price support, the country implementing the support measure effectively chooses to have higher domestic prices for the supported commodity than the world price. Such support is often maintained through import restrictions. Support to the use of certain inputs, on the other hand, generally lowers the costs of downstream input-purchasing activities, giving them a direct competitive advantage on both domestic and foreign markets.

... and it is often given to ailing industries

Support may be justified if it lowers the long-term marginal costs to society as a whole. This may be the case with support to ‘infant industries’, such as producers of renewable energy, which will not be viable until they reach a certain level of production. Support can allow the infant industry to develop its scale effect benefits and ability to reduce external costs. Ideally, such support should be given on a temporary, perhaps reimbursable, basis and only when the developments would not take place if the government support was not available. The majority of support, however, is given instead to mature, ailing industries to shelter them from competition. This policy is often both costly and ineffective in the long run. Technological change and the development of new product markets will generally lead to an even further loss in the competitiveness of the supported industry. As a result, larger amounts of support will be required in order to maintain the industry.

Widespread support will be ineffective at protecting the designated industry, but will still be environmentally-damaging and costly

Support is also sometimes used to protect industries from the effects of high tax rates in a particular taxation regime, often through tax concessions or exemptions. This highlights the necessity of analysing support measures in the broader context of the prevailing taxation regime and the importance of developing measurements of their combined effects on costs.

If support is given to the same sector by a number of countries (such as with the wide-spread use of preferential fuel tax rates to energy intensive industries, including agriculture and fishing), the trade distortions that arise from

the support will be small. The support will, however, both lead to a diminished incentive to reduce material and energy inputs and it will delay, or even prevent, the entrance of other technologies or products into the market. Thus, although the support may be relatively ineffective in attaining the social or economic goals it is intended to, it may still cause significant environmental damage. In addition, all the countries implementing the support will be spending considerable amounts on it, without necessarily increasing the competitive advantage of the supported industry relative to international competitors.

Political analysis is often biased in favour of support

It is often the *fear* that the supported sector will lose competitiveness, especially in the short run, that results in opposition to reductions in support levels. Although this fear will be justified in a number of cases, it is often exaggerated. This can be seen in the wide variety of actual support reductions that have taken place in OECD Member countries without significant losses in competitiveness. In many cases, support is used to prop up declining industries, merely postponing their certain demise at the expense of taxpayers and consumers. The scope for unilaterally reducing support without significantly harming the supported industry, as well as the potential environmental benefits from such reductions, will be more limited in small, open economies.

To determine whether support removal will substantially reduce the competitiveness of an industry, let alone growth and employment in the economy as a whole, requires a comprehensive analysis, including the full economic costs of supporting the industry. However, there are considerable analytical problems in disentangling these issues. Support tends to benefit individual sectors or small regions quite significantly, while the costs of support are dispersed over a larger, less organised base. As a result, the benefits are often easier to calculate than the larger, economy-wide costs of the support. Further, the gains to society as a whole from support removal will often only materialise after some time. Because of these difficulties, the benefits of support measures tend to receive more attention in the political arena than the full costs of the support.

5. IMPLEMENTATION STRATEGIES

5.1 Addressing effects on equity and employment

Social objectives can often be achieved at lower cost

Although reforming or reducing support may have short-term negative employment or income effects on the workers who benefit from the support, these effects must be balanced against the potential social costs to those who would otherwise have to pay for the continuance of the support. Because of inefficiencies imbedded in support schemes, the amount of support that is given — generally by consumers or taxpayers — often far exceeds the amount received by the intended recipients. In addition to the loss of income experienced by these paying groups as a result of the support, its payment may also have adverse distributional effects. Market price support measures, for example, force consumers to pay artificially high prices for products. If the supported products are ‘necessary’ goods, such as food stuffs or energy for heating, the funding of the support may have a regressive distributional incidence, such that lower income groups spend a larger portion of their income on paying for the support than higher income groups.

It may be desirable to compensate those who would suffer from the removal or reform of support

If it is decided that a support measure should be reformed or removed, compensation can be offered to those who would lose from the support reduction through mechanisms such as

- *temporary compensatory payments*: compensatory payments which are decoupled from output levels can be paid on a temporary basis to ease the transition of the workers towards new employment opportunities, such as through job retraining schemes, or to restructure the industry so that it can compete successfully without the support;
- *other adjustments*: adjustments can be made to the existing social security, fiscal or other systems — depending on national policies and priorities — to counter any potentially inequitable effects of support removal. However, since these adjustments tend to be permanent rather than temporary, they are often not suitable for compensation that is intended to ease the economic hardship of previously supported workers over a transitional period.

Where required, these compensatory mechanisms can sometimes be funded through a partial recycling of the funds previously used to maintain the support.

5.2 Transparency and co-operation

Increased transparency can clarify who will gain and who will lose from the removal of support measures

In order to hold informed discussions on the benefits and costs of support measures, it is essential that the support policies are as transparent as possible. An important step towards achieving transparency is the development of indicators to measure and monitor existing support levels. Unfortunately, internationally comparable data on support levels are currently available for only a few sectors.

Domestically, increased transparency of support measures and the monitoring of their levels can contribute to a better understanding of the effectiveness of the measures in achieving their economic or social goals, and of what environmental effects they may have. As discussed above, the beneficiaries of support are often more visible than the losers and the benefits easier to calculate than the costs. Increasing the transparency of support can help to redress this balance.

In the international arena, increased transparency and internationally comparable data on support measures is essential for securing co-operation to reduce trade barriers and liberalise markets. Such information can also contribute to a clearer understanding of when a country will realise a net benefit through unilateral support reduction and when multilaterally-agreed solutions will be required.

6. MAIN FINDINGS

Based on the reviewed literature and case studies, and as analysed in more depth in Improving the Environment through Reducing Subsidies, Part II: Analysis and Overview of Studies, the main findings of this report are the following:

The existence of support and how it affects the economy

1. A subsidy can be defined as “environmentally-harmful” if it encourages more environmental damage to take place than what would occur without the subsidy. What qualifies as an environmentally-harmful subsidy will vary over time and place. Where there are clearly defined national or common environmental goals, such as the reduction of greenhouse gases, environmentally-harmful subsidies will be more readily identifiable.
2. The majority of support in OECD Member countries is conditional either on input use or output levels. The largest quantities of support are implemented through market price support, which increases the marginal revenues of the recipient sector at the expense of consumers and taxpayers.
3. Although the rather limited available data suggests that a decline in overall support assistance is taking place, in most cases this decrease is taking place very slowly.
4. The levels and trends in support within individual Member countries, sectors and products are very uneven, with some even showing increasing levels of support.
5. Available data indicate a modest shift from support conditional on inputs and products to direct income support, the latter often being in compensation for reductions in market price support. Although this will often reduce the negative environmental effects of the support, these benefits will be reduced if the link between the payments and environmentally-harmful practices is not fully severed.

6. Support in OECD Member countries is mainly given to inefficient firms in mature industries (including agriculture) in order to protect these industries from foreign competition. But ongoing technical changes and market developments add to the competition faced by these industries. If a supported industry does not adapt to these changes, it may be put at an even greater competitive disadvantage, thus necessitating higher levels of support to maintain its ongoing viability. Therefore, the maintenance of a given level of protection may require increasing levels of funding.
7. It is the combined effect of the support measure that is used and the taxation regime within which it is applied that will determine the economic and environmental effects of the support. Thus, if the same support measure is applied under different taxation regimes, the effects of the support will differ.
8. Support measures consist of combinations of direct financial support mechanisms and the regulations which accompany them and that reinforce their effects. Their effectiveness in reducing competition depends on the combination as a whole, including their effects on upstream and downstream economic activities as well. Removing only one element from a combination of support measures and regulations will often have only a limited impact, and can sometimes actually increase inter-sectoral distortions.
9. The mechanisms which link support levels and environmental degradation are complex. Thus, the effects of a given support measure on the environment will be mediated by three intervening linkages: the impact of the support on the volume and composition of output in the economy, the mitigating environmental policies in place, and the assimilative capacity of the affected environment. As a result, the level of support to a particular

***Complex linkages
between support and its
environmental effects***

industry will not necessarily reflect the level of environmental damage that will occur as a result of the support.

10. Support can have weak beneficial effects on incomes, growth and employment in the intended recipient sector, while having strong adverse effects on the environment.
11. Although it is difficult to calculate the exact environmental effects of support policies, a quick scan of the support type and the characteristics of the recipient sectors can often indicate the potential environmental effects of support removal through an examination of:
 - the point of impact of the support measure, and its relative share in (marginal) costs or revenues;
 - the direct and indirect links between the point of impact of the support and the large and polluting substance flows through the economy; and
 - the elasticities of demand and supply on both the input and output markets — these determine the magnitude of volume responses to price changes and the proportion of the support that leaks away to sectors other than the targeted sector.

By examining these characteristics, a quick scan of support measures to be prioritised for reform or removal can be made.

12. The positive environmental effects of support removal will often become apparent only after a relatively long time span. This will particularly be the case where past support has encouraged investment in long-lasting infrastructure, thus locking-in the use of certain inputs or processes for years to come. Any estimates of the environmental benefits of support removal will necessarily depend both on the assumptions made regarding the potential technical developments that will occur in the future and the time horizon examined.

***Quantitative analysis
can provide only partial
answers***

13. Support removal, in particular with respect to support which is coupled to input or production processes, will encourage a broader scope of technical developments than if the support is continued. As a result, it is likely that the total environmental benefits of support removal will be larger than estimates based on empirical evidence can predict, both because of the increasing benefits that accrue over longer time periods and because of the greater range of technological developments made possible by the support removal. As a result, no matter how thorough they are, analyses of support removal will always be open to question.
14. Support removal can cause hardships, but most of these can be mitigated through the use of careful implementation strategies, including the possibility of compensating those who might suffer as a result of the support removal.

7. POLICY CONCLUSIONS

As per the mandate given by the OECD Council at Ministerial Level, the conclusions listed below refer to all support measures that are “environmentally-harmful” and, therefore, do not apply to those that effectively improve environmental quality. The conclusions also reflect that, in some circumstances, detailed local-level analysis will be necessary to determine the exact environmental effects of support removal or reform.

General Conclusions

Getting the prices right

Market prices do not always reflect the true costs and benefits to society of economic activities. This often aggravates environmental pressures. In order to ensure that prices do reflect social costs, it would be necessary to both remove any support measures in place which artificially lower the private costs of the activities and to better internalise negative external effects through appropriate regulations or economic instruments.

When an environmentally-malign activity is supported, a policy to create a price differential in favour of less environmentally-damaging alternatives through supporting the environmentally-benign activities is only a second best policy. A preferable approach would be to remove any existing support from the environmentally-malign activities and to better internalise external costs they may generate.

Increasing the transparency of support

Support is often introduced to serve the interests of specific sectors or regions in the economy. The full effects of the support are, however, generally more widespread, less understood, and often only partially analysed. Many sectors and groups in the economy may be affected besides the intended recipient sector, sometimes positively, but more often negatively. It is essential that the transparency of support measures be increased in order that these trade-offs between sectoral and general interests in society can be clarified.

Prioritising support measures to be eliminated or reformed

The removal or reform of support measures that are linked to production or input levels should be a high priority. Such measures encourage both the emission of unnecessary levels of pollution and waste and the squandering of natural resources, and so may counteract policies directed at increased resource productivity. The removal or reduction of such support will

- * decrease government spending, reduce pollution and the costs of applying environmental policies, and increase the overall efficiency of the economy, thus leading to higher government revenues in the long run; and
- * stimulate technological change in directions that are crucial for future environmental quality, notably through increasing resource productivity and curbing pollution from non-point sources. If support is conditional on a particular process or product, the supported process or product will be “locked-in” and the development of potential environmentally-beneficial technological innovations will be limited to simply improving on these products or processes.

In prioritising support measures for reform or removal, a comprehensive approach is preferred and, where possible, should include an examination of all the relevant markets which are affected by the support. The final analysis should be based on the net, overall effects of support reform or removal.

Countries may wish, in particular, to prioritise for reform or removal those support measures that have immediate budgetary consequences.

Alleviating possible hardships of support removal

Reducing support causes financial gains and losses, which will often be unevenly spread. It may be desirable to devise policy packages to alleviate the possible hardships associated with support removal, using measures that do not link the transfers to particular practices or the use of particular inputs or factors of production (i.e., capital or land).

A well directed environmental policy is also required

Releasing market forces through support reform or removal and increasing the effectiveness and efficiency of regulations (regulatory reform) will stimulate technological change — which is vital for achieving environmental objectives. In particular, technological changes that increase resource productivity are amongst the most promising for achieving environmental objectives. Technological change may, however, also have adverse effects on the environment. In order to reap the maximum benefits from support reduction, an effective and well-directed environmental policy will also be required to guide developments and changes in the most beneficial directions.

Unilateral support removal

Often a thorough identification of all the beneficiaries and losers of a support policy is required to adequately understand the full costs and benefits of support removal. In many cases (particularly when support is given to ailing industries), successful and profitable support reduction does not require an internationally agreed upon policy between many countries. There are various examples of unilateral support reductions which have resulted in net benefits to the economy as a whole and, occasionally, without loss of competitiveness of the sector involved. OECD Member countries should identify such possibilities and implement unilateral support reductions where net benefits can be realised.

Further OECD work

Shared goals

Where OECD Member countries have, or develop, common environmental goals or principles — in particular those under global or regional environmental conventions, such as, for example, the Kyoto Protocol to the U.N. Framework Convention on Climate Change, the U.N. Framework Convention on Biological Diversity or the UNECE Convention on Long-Range Transboundary Air Pollution — the removal of support measures which encourage the environmental damage can contribute towards the

attainment of these goals and the polluter pays principle. As such, support removal can be seen as one of a number of policy tools for realising environmental objectives.

Removing obstacles

It is often the *fear* that a country will incur a net loss through support removal that prevents such actions, even when they would prove beneficial overall. A primary obstacle to overcoming such misperceptions is the lack of available data or a clear understanding of the benefits and losses of support removal. Increasing transparency and gathering the relevant data can help to remove this obstacle. In addition, even in situations where countries can realise net benefits through unilateral support reduction, negotiating co-operated multilateral reductions can increase the political acceptability of the policies.

Data collection and monitoring progress

International co-operation, as well as any unilateral actions, requires reliable and comparable information on support levels in Member and non-Member countries. In light of the limitations of the current data on support for most sectors and its effects on the environment, the OECD should prioritise the collection of such information.

Monitoring the existence of support measures and their removal — particularly with respect to support relating to agriculture, energy and materials — is essential for increased transparency, political viability and co-operative support removal. Where data is incomplete or unavailable, the OECD should develop appropriate measures of support levels, such as the producer and consumer subsidy equivalents, and publish the relevant data and trends in new or existing periodical reviews.

It is important that data is collected on support measures and their environmental effects which relate, in particular, to the shared goals of OECD Member countries.

International co-operation

International co-operation in reducing support levels can facilitate the process of support removal and limit any potentially negative side effects that may exist. In particular, negotiating multilateral reductions of support which is common in most countries can lead to increased environmental benefits and reductions in government expenditures, with little or no loss of competitive advantage in the affected sectors. The OECD should identify true prisoners' dilemmas⁵ and suggest appropriate multilateral strategies for support removal where required.

⁵ A prisoners' dilemma situation arises if all countries would realise a net benefit if all removed their support to a particular industry or sector together, but any individual country would realise a net loss (at least in the short term) if they removed their support without the co-operation of the others.

OECD PUBLICATIONS, 2, rue André-Pascal, 75775 PARIS CEDEX 16
PRINTED IN FRANCE
(97 98 09 1) ISBN 92-64-16091-4 – No. 50135 1998

IMPROVING THE ENVIRONMENT THROUGH REDUCING SUBSIDIES

Part II: Analysis and Overview of Studies

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

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Également publié en français

RÉDUIRE LES SUBVENTIONS POUR AMÉLIORER L'ENVIRONNEMENT
Partie II : Analyse et synthèse des études

Reprinted 1999

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FOREWORD

OECD Environment Ministers in February 1996 supported the 1995 request by G-7 Ministers of the Environment that the OECD undertake “a wide-ranging study of the effects of subsidies and tax disincentives to sound environmental practices in various economic sectors and the costs and benefits of their elimination or reform”. This led the OECD Council at Ministerial level on 21 and 22 May, 1996 to request an “analysis of the elimination or reform of environmentally-harmful subsidies”. This publication presents an overview of the analysis and case studies used in the report on *Improving the Environment through Reducing Subsidies*, which was undertaken in response to both mandates. The first part of the report provides a brief summary of these findings.

This report draws heavily on the results of a number of recent OECD studies, as well as on the OECD’s ongoing and previous work on the environmental effects of support to various sectors, including agriculture, energy, transport and industry. The report primarily collects and synthesises the available work on support measures and their environmental effects to present an overall picture of the costs and benefits of support reform or removal. In addition, a few new case studies have been undertaken in order to fill in some of the gaps in the available literature.

The work on this project was overseen by five *Ad hoc* Meetings of Experts on Subsidies and Environment, which brought together both environmental and fiscal specialists. The report is published on the responsibility of the OECD Member countries.

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1. INTRODUCTION

1.1. HISTORICAL CONTEXT AND MANDATE

The environmental effects of support to energy, agriculture and transport have attracted considerable scientific and political interest since the mid-1980s. What estimates of support are available indicate that total support levels in OECD Member countries are declining slowly, although they are still significant. Given the volumes of pollution associated with energy use, agricultural production and transport, various studies have suggested that a reduction of support to these sectors could lead to environmental benefits as well as the economic gains that would result from reduced government expenditure and improved economic efficiency.¹ A number of studies, notably those by the World Resources Institute, Larsen and Shah (1992), Burinaux, *et al.*, (1992) and Steenblik and Coroyannakis (1995), have attempted to define more explicitly the links between support and environmental effects. These analytical studies have shown that the linkages between support and the environment are complex and often indirect. However, because of the great potential for “win-win” situations – whereby support removal could benefit both the economy and the environment – OECD Environment Ministers in February 1996 supported the 1995 request by G-7 Ministers of the Environment that the OECD undertake “a wide-ranging study of the effects of subsidies and tax disincentives to sound environmental practices in various economic sectors and the costs and benefits of their elimination or reform”. This led the OECD Council at Ministerial level on 21 and 22 May, 1996 to request an “analysis of the elimination or reform of environmentally-harmful subsidies” (Annex 1).

This report draws heavily on the results of a number of recent OECD studies, including the results of an OECD workshop on the linkages between subsidies and the environment (OECD, 1996a), the OECD study on *Reforming Energy and Transport Subsidies: Environmental and Economic Implications* (1997a), two OECD reports on government support to industry (OECD, 1992a and 1996b), and the OECD’s extensive work on the environmental effects of support to agriculture. This report primarily collects and synthesises the available work on support measures and their environmental effects to present an overall picture of the costs and benefits.

In addition, a few new case studies have been undertaken in order to fill in some of the gaps in the available literature.

1.2. OBJECTIVES OF THE STUDY

Given that the available internationally-comparable data do not allow for an easy distinction to be made between environmentally-harmful and less harmful support and tax incentives, and the fact that supplementing the rather scarce available data would require time and funds that were not available for this project, the main objective of the report has been to identify factors that might indicate whether a particular support or tax incentive has significant adverse effects on the environment. More precisely, the present report aims to:

- *distinct characteristics of support measures, tax incentives and market conditions that are reliable indicators of significant adverse effects on the environment, and*
- *identify strategies to implement the reduction of support, including those that can be carried out through regulatory reform and supplementary tax reform, both nationally and internationally.*

This study does *not* provide a concrete list of support measures that should be reformed or eliminated. It does, however, offer governments advice on how they can prioritise support measures for removal or reform and reviews some important implementation strategies, including those that require international co-operation.

1.3. SCOPE OF ANALYSIS

1.3.1. “Subsidies and Tax Disincentives to Sound Environmental Practices”

Support measures come in a wide variety of forms, such as direct and indirect payments, tax expenditures through tax concessions to specific industries or regions, market price support and other regulations that enhance the competitive position of particular industries or sectors. They have in common that they shelter certain sectors or products from competition. Although precise definitions of subsidies have been agreed upon for certain purposes, and statistics have been developed to measure them – such as the producer subsidy equivalent (PSE), the consumer subsidy equivalent (CSE) and the effective rate of assistance (ERA) – there is less consensus on the appropriate definition to be used for analysing the economic and environmental effects of support policies. The divergencies in support definitions are based on many philosophical and practical bench-marking issues, and the appropriate definition will depend largely on the precise question under consideration. Consequently, a wide variety of definitions of “subsidies” have been applied in the (case) studies under review. There are, for example, studies that include external environmental effects in the definition of a “sub-

sidy", on the argument that externalities constitute a significant "implicit" subsidy from those who suffer the environmental damage to those who cause it. Other studies, however, do not define these external effects as a subsidy, but examine externalities only when they are the result of more narrowly defined subsidies. In the context of this study, environmental externalities are treated primarily as a *consequence* of support policies. The main exception is in the description of previous case studies of support to the transport sector where externalities were included in the definition of support. Whether externalities or implicit subsidies are included in the definition of support or are analysed as the unwanted results of support is not of practical interest to this study. Included in the definition of support or not, they constitute an important motive for policy action.

The behavioural response of the recipient sector to the support measure will *not* depend on "subsidies" or taxes *separately*, but on their *combined* effect (on relative prices). When analysing the effects of "subsidies", one must therefore take into account the relevant prevailing tax system, even more so because a change in the level of subsidisation can lead to changes in the amount of taxes required to fund the support. As a result, one case study developed a numerical illustration of the degree to which differences between tax jurisdictions may affect the impact of otherwise identical support measures (Chen, 1998 forthcoming). A wider interpretation of the mandate might have included an examination of the effects that changes in "normal" tax rates² (*e.g.*, on labour, capital or income) have on the choices between sound and less sound environmental practices. Such an interpretation, however, was beyond the scope of this study. In addition, previous studies (OECD 1996*c*, 1997*b*) have examined the effects of an increase in energy taxation and a decrease in labour taxation on both the environment and the economy, so there was no need for this work to be repeated here.

The mandate requests that this study examine the effects of "subsidies and tax disincentives to sound environmental practices", or of "environmentally-harmful subsidies". Therefore, only support removal or reform where there is a potential *win-win situation* (benefits to both the economy and the environment) are examined in this report. Because the term "subsidies" has a distinct meaning in international trade negotiations and because relevant regulatory reforms have also been included in the analysis, this report uses the term "**support**". Accordingly, the "subsidies and tax disincentives" examined in this study are limited to:

all kinds of financial support and regulations that are put in place to enhance the competitiveness of certain products, processes or regions, and that, together with the prevailing taxation jurisdiction, (unintentionally) discriminate against sound environmental practices.

Given the focus of this study, support can be classified according to its immediate effects on government budgets and the elements of the firm's balance sheet that are affected by the support (points of impact or conditionality) (Table 1.1). Both distinctions are of great importance when deriving the character-

Table 1.1. **Classification of principal support measures by budgetary effects and points of impact**

Points of impact/ support conditionality	Effects on government budgets	
	On-budget	Off-budget
Outputs	• Deficiency payments • Sales premiums • Preferential sales tax and VAT rates	• Market price support – Border Protection (tariffs, quantitative import controls) – Market access restrictions – Government brokered sales contracts
Raw material and intermediate product inputs	• Support to material and energy input (e.g., energy, fertilisers, irrigation water) • Provision of infrastructure below long run marginal cost	• Material and services in kind
Capital and labour inputs or Income or profit earnings	• Support to non-material and non-energy inputs (e.g., labour, capital equipment) • Accelerated depreciation allowances (if selective) • Income tax concessions (if selective) • Concessional credit • Debt write off • Support to research and development (e.g., on production techniques, safety or environmental protection)	• Concessional credit • Royalty concessions • Low rate of return requirements • Exemptions from environmental standards • Allowing insufficient provision for future environmental liabilities

Notes: – There are many regulations which are not obvious support measures, and their financial effects may be indirect and difficult to assess, such as restrictions on third party access to electricity distribution infrastructure. Such a measure may have profound effects on competition (essentially ensuring a monopolistic market), but its precise pecuniary effects on corporate balance sheets is difficult to calculate. Only the more conspicuous support measures have been listed in Table 1.1 above. The “implicit” subsidies, that result from the non-internalisation of externalities are also not listed.

– The off-budget forms of support may have second order effects on the budget. Increased efficiency of the economy as a whole, which will generally result from lower support levels, may increase revenues without increasing the tax burden as a percentage of GDP. Off-budget support measures are also often part of larger integrated support measures, and so are often accompanied by other support policies which do have direct budgetary effects.

Sources: Adapted from Steenblik (1995) and Centre for International Economics (1988).

istics that imply that a reduction in support could result in less government spending while also improving the environment. The immediate budgetary impact is a characteristic of the support measure that is obviously of interest to an analysis of the benefits and costs of support removal. Many support measures are financed directly by government, so their removal will have a positive and imme-

mediate impact on government budgets. The removal of off-budget support can also benefit the budget, but in the longer term. It will generally lead to an increase in efficiency within the economy, which can have a positive effect on reducing budget deficits.

The points of impact of the support are key factors that influence the economic as well as the environmental effects of the support. But other factors, such as other government policies and autonomous technical and economic changes, will also serve to reinforce or countervail the effects of a given support measure.

1.3.2. Various sectors

Agriculture, fisheries, transport, energy and heavy industries are the sectors that enjoy the most substantial support, directly or indirectly, through market price support (all measures that politically determine the domestic “market” price of the good or service), deficiency payments, tax expenditures and support to energy, water, and material inputs. They also use large volumes of natural resources and generate significant amounts of waste and pollution. As a result, the potential environmental effects of support to these sectors is the main focus of this report. In analysing the costs and benefits of removing support, it is necessary to not confine the analysis to the environmental effects of these sectors alone, but to also include their *effects on preceding and subsequent stages of production* (referred to as upstream and downstream activities respectively). These effects can be substantial. Taking all the up- and downstream effects into account requires an analysis of the whole economy, depicting all the intermediate deliveries between sectors. A number of the reviewed case studies more or less take such a comprehensive approach, notably in the field of energy, using input-output, partial- or even general-equilibrium models. Others have adopted a more limited scope, looking more exclusively at the recipient sector itself. A few of the new case studies also illustrate the upstream and downstream effects of support measures, particularly in the agricultural and industrial sectors.

Most of the available transport case studies focus on the question of whether different modes of transport pay their fair share in covering the costs of transport infrastructure. An additional case study commissioned by this project investigated whether the overall taxation and support schemes lead to different effects on the relative marginal costs of the various competing modes of transport in four European countries (Pillet, 1998 forthcoming).

1.3.3. Analysing the costs and benefits of the reform or elimination of support

Assessing the economic and environmental costs and benefits of support reform or removal requires a fiscal and an environmental “incidence analysis”. A

fiscal incidence analysis indicates which sectors or groups lose or gain by the support once it has changed the relative prices, production volumes and incomes in the entire economy. It results in estimates of the “spill over” or “leakage” effects, that cause the recipient sector to retain only a part of the initial support. A fiscal incidence analysis also indicates to what degree the initial objectives of the support measures – in terms of *employment, growth and income*³ for the recipient sector and the economy as a whole – are achieved. Few fiscal incidence analyses of support measures have been carried out in practice. A limited number of the reviewed energy case studies (OECD, 1997a) examined the overall economic effects of support removal and found positive, albeit small, effects on economic growth, dependent on the way the decrease in government spending was recycled. These results uphold the hypothesis that support measures may often not achieve the positive effects on employment, incomes or economic growth that they are intended to. The results have also been corroborated by work on the efficiency of income transfers in agriculture (OECD, 1995).

An *environmental* incidence analysis, by contrast, describes the changes in potential⁴ pollution levels that would result from the support measures, any changes in environmental policy that might be implemented to counteract these changes in potential pollution levels, and the ultimate effects of the pollution on the environment after the environmental and economic feedback mechanisms have worked out.

The fiscal and environmental incidence analyses overlap to a large extent in scope. When the economic effects of a support measure spill over to other sectors (the suppliers or the customers of the intended recipient sector, or both), these sectors in turn will expand or contract their businesses and, consequently, their potential environmental impacts. But the fiscal and environmental incidence analyses also differ significantly, as the potential environmental effects are not necessarily proportionate to the efficiency of the support measure in reaching the intended recipients. It is, for example, quite feasible that the recipient sector retains only a small proportion of the initial support measure, but significant levels of environmental damage still occur because of the support. Conversely, it is also possible that a sector successfully retains most of the support, but still induces behavioural changes among its suppliers and customers that are detrimental to the environment.

Combining an environmental incidence analysis with a fiscal one can indicate situations where a reform or removal of support may have only a small net cost, or perhaps even a net benefit, in terms of the income, employment and economic growth of the recipient sector and the economy as a whole, while still yielding substantial benefits in terms of environmental improvement.

Support may also induce levels of production that are unsustainable and ultimately lead to the collapse of the supported industry, for instance through the

direct or indirect support to the use of irrigation water and to fisheries. An analysis of the full costs and benefits of reducing support to these activities should include the effects of a decreased pace of resource depletion, and its effect on the supported industry and the general economy (up- and downstream effects). While one of the new case studies on agriculture investigated the complementarity of support to agriculture and the use of irrigation water (Rainelli and Vermersch, 1998 forthcoming), it did not examine the full environmental effects of the changes in irrigation water use. The effects of support to fisheries is currently being studied in a new project carried out under the aegis of the Fisheries Division of the Agriculture Directorate of the OECD.

In some instances, it may be found that the use of a particular support measure (although being a second best solution) may be the only practical method available for achieving a given policy objective. If the support has environmentally-damaging effects, removing it may involve a trade-off between environmental and other objectives.

1.3.4. Structure of the report

In the next chapter, a summary is presented of the trends and current levels of support in OECD Member countries. Chapter 3 provides a conceptual framework for examining the effects of different support measures, including a description of the linkages between support and environmental pressures. The results are used to develop a methodology to identify those support measures that are inefficient in achieving their employment, sectoral or regional objectives, and are likely to have a substantial negative effect on the environment. Thus, the methodology can be used to help identify those support measures whose reform or removal might lead to “win-win” benefits for both the economy and the environment. Chapter 4 describes the empirical evidence on the effectiveness of existing support measures, as identified in Chapter 2, in achieving their goals and the potential environmental benefits that might be expected to result from their removal. Chapter 5 outlines potential strategies for implementing support reform or removal, with an emphasis on resolving concerns about the potential equity, employment and competitiveness effects of support removal. Chapter 6 summarises the main findings, and Chapter 7 draws together the important policy conclusions of the report.

2. THE DEVELOPMENT OF TRENDS AND CURRENT LEVELS OF SUPPORT

2.1. OVERVIEW

Evidence shows that the bulk of support in OECD Member countries is directed towards *agriculture*, with the total transfer in 1996 estimated to be US\$297 billion, or 1.3 per cent of GDP. Almost 60 per cent of the total agricultural producer support⁵ is composed of transfers from consumers of agricultural produce to the producers through market price support policies. As discussed below, total support to agriculture is declining and the composition of the support is changing. Estimates indicate that support to *energy production and consumption* is also substantial, with support to coal producers alone estimated to be almost US\$10 billion in 1995-96. One estimate indicates that total energy support in OECD Member countries may amount to approximately one-quarter of the total level of agricultural support (de Moor, 1997). Only an estimated 12 per cent of overall energy support is in the form of market price support (although an estimated 57 per cent of coal producer support), with the bulk instead in budgetary subsidies and the public provision of infrastructure, complementary goods and research and development. While there are no current calculations of total support to *industry*, available evidence indicates that it may be significant, particularly in the forms of non-reimbursable grants and tax expenditures (OECD, 1996b). Support levels to *transport* are generally more difficult to calculate and no aggregate estimates exist. However, three recent case studies undertaken for the OECD demonstrate that there are a number of countries whose transport-related taxes and charges do not cover the full private costs of providing and servicing their transportation systems, let alone the full social costs, and that large cross-subsidies between different user groups exist.

Changes to support levels are often accompanied by regulatory changes and developments. Some of the recent reductions in support levels and changes in the composition of support have been the direct result of an increased interest in the benefits of regulatory reform. Thus, in 1995 OECD ministers requested an examination of the significance, direction, and means of regulatory reform in Member countries. Based on an analysis of both the experiences of countries that have under-

taken reforms and the results of predictive models, the report (OECD, 1997c) concluded that regulatory reforms which enhance competition and reduce regulatory costs can increase efficiency, reduce prices, stimulate innovation and improve the ability of economies to adapt and stay competitive in a rapidly changing economic environment. The reform and removal of support measures is an essential component of such a reform process, and one that a number of Member countries have already begun implementing. Regulatory reform can lead to improvements in environmental quality as well as economic and government efficiency.

2.2. AGRICULTURE

2.2.1. Current support levels and trends in OECD Member countries

Although agriculture continues to be the sector with the largest levels of support, the overall level of support as a percentage of total production value

Table 2.1. **Agricultural transfers in OECD Member countries associated with agricultural policies**

	1986-88	1995p	1996e	% change 1986-88 to 1996	% change 1995-1996
Producer Subsidy Equivalent (PSE)					
Total PSE					
US\$ billion	159	180	166	4.7	-7.6
ECU billion	144	137	131	-9.4	-4.8
Percentage PSE ^a	45	40	36		
Producer Nominal Assistance Coefficient ^b	1.8	1.6	1.5		
Consumer Subsidy Equivalent (CSE)					
Total CSE					
US\$ billion	-119	-120	-95	-19.8	-20.8
ECU billion	-108	-92	-75	-30.4	-18.4
Percentage CSE ^a	-37	-29	-23		
Consumer Nominal Assistance Coefficient ^b	1.6	1.4	1.3		
Total transfers^c					
US\$ billion	279	333	297	6.5	-10.8
ECU billion	253	255	234	-7.6	-8.1
% share of GDP	2.2	1.5	1.3		
Per capita in US\$	340	376	334	-1.8	-11.2
Per capita in ECU	309	288	263	-14.9	-8.7

p = provisional; e = estimate.

a) Percentage changes in the PSE and CSE totals and total transfers have been calculated from unrounded data; all monetary values are in nominal terms.

b) Nominal assistance coefficients (NACs) are indicators of the wedge between domestic and world markets created by agricultural prices. The producer NAC is the ratio of the border price in national currency plus the unit PSE, relative to the border price. It expresses the value of transfers to producers in relation to border prices. The consumer NAC is the ratio of the border price in national currency plus the unit CSE, relative to the border price. It is an indicator of the gap between domestic consumer prices (measured at the farm gate) and world prices.

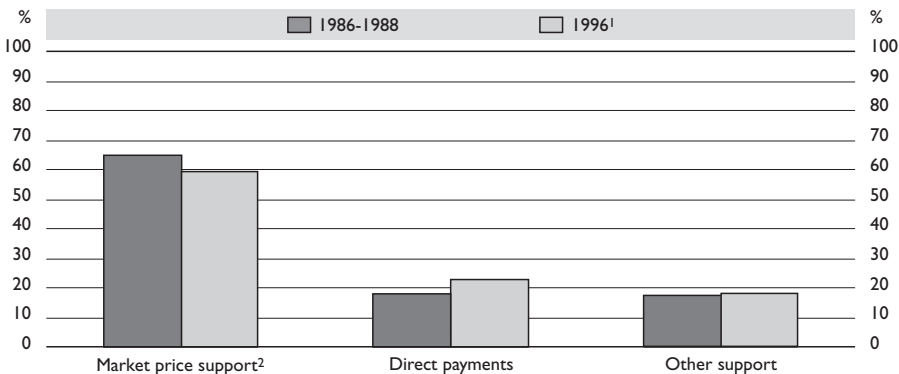
c) Total transfers are not the addition of the PSE and CSE; they cover the total value of production and include not only transfers to agriculture, as measured by the PSE and CSE, but also other transfers associated with agricultural policies.

Source: OECD (1997d).

(measured by the percentage PSE)⁶ has been slowly decreasing since the 1986-88 period, falling from 45 per cent to an estimated 36 per cent by 1996. Table 2.1 shows the changes in average transfers in OECD Member countries associated with agricultural policies.

There are a few important trends that can be seen in the levels and composition of agricultural support in OECD Member countries. First, there has been a reduction in the aggregate level of support to agricultural producers over this period. The predominant cause of this reduction has been the increasing world prices experienced over the period, while producer prices have remained relatively stable. Second, there has been a general shift away from commodity-based market support policies and towards direct payments and other support policies which are not the result of a direct transfer from consumers to producers (see Figure 2.1). In some cases, however, the benefits of this trend of moving towards decoupled support has been weakened by countervailing changes in particular commodities or countries. For example, the potentially beneficial environmental effects of the changes in the composition of agricultural support have been undercut to some extent by relative increases in total support to beef and veal producers.

◆ Figure 2.1. **Composition of agricultural support in OECD Member countries, as a per cent of total PSE**



1. 1996 is an estimate. The Czech Republic, Hungary, Mexico and Poland are not included in the OECD average.

2. Net of producer levies and feed adjustment.

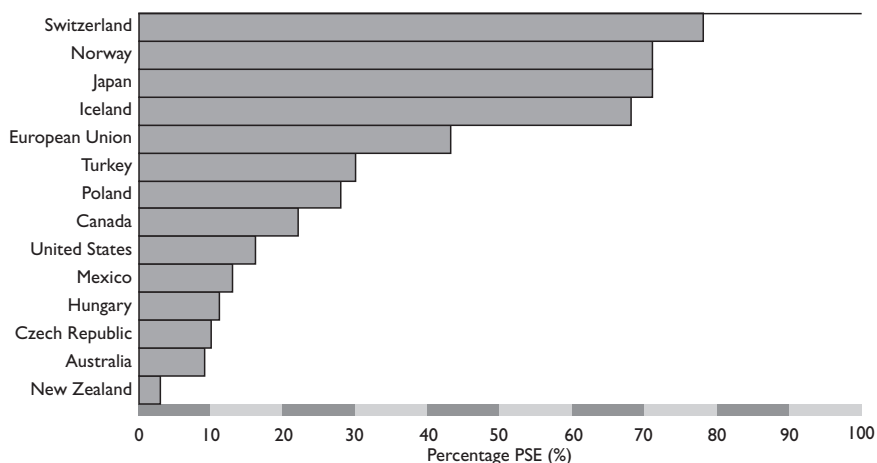
Source: OECD (1997d).

2.2.2. Variations in support between Member countries

As can be seen below, levels of agricultural producer support vary significantly between different Member countries, from under 5 per cent of total production value in New Zealand to almost 80 per cent in Switzerland.⁷ While most OECD Member countries have been experiencing a decline in the PSE over recent years, Norway, Switzerland and the European Union have maintained relatively stable percentage PSEs. Both Switzerland and the European Union have had a marked shift in support measures towards direct payments per hectare or headage and away from market price support. It is difficult to analyse the trends in a number of Member countries (particularly Turkey, Mexico, the Czech Republic, Hungary and Poland) because of the effects economic transition and upheavals have had on their economies in general. However, it appears that for most countries the percentage PSE for agriculture has remained stable or decreased over this period. There has also been considerable variation between support levels to different commodities, with PSEs and CSEs for crops having decreased fairly consistently since 1986-88, while support to beef and veal has increased.

Although there has been some overall improvement in the market orientation of agricultural policies, progress has been limited and uneven across OECD

◆ Figure 2.2. **Estimated agricultural percentage PSEs for Member countries, 1996**



Member countries. There is some concern that the recent reductions in support was achieved through the maintenance of stable policy-determined prices while world prices rose (thus creating a smaller gap of “support” between the policy-determined price and the world market price), rather than through a concerted effort to reduce support levels.

2.2.3. Policy reform

Environmental pressures, as well as autonomous technological developments and market trends, have spurred a number of governments in OECD Member countries to undertake processes of comprehensive reform of agricultural policies in order to encourage farmers to improve agricultural practices. In 1987, OECD ministers committed themselves to the reform of agricultural policies, including a “progressive and concerted reduction of agricultural support” and “a shift away from measures linked to production or to factors of production” (OECD, 1998).

In many cases, reductions in support levels and the reform of other agricultural policies must be implemented together in order to efficiently achieve the desired behavioural responses at the production level. If a support measure is maintained which runs counter to the autonomous market changes and technological developments that are taking place, the financial burden of the support will

Agricultural reform in New Zealand

New Zealand is the only Member country to have already implemented comprehensive agricultural reforms, although several other countries have engaged in substantial reforms. The New Zealand reforms took place over the 1984-87 period and were part of an overall economic reform and deregulation process. The main transitional assistance provided to farmers during the reform period was help with the restructuring of farm debt, a once-off measure.

Following the removal of subsidies, sheep numbers and the use of fertilisers and pesticides declined, and there was an increase in afforestation. There was an initial decline in fertiliser sales in the early 1980s when the government shifted from input assistance to an emphasis on output subsidies, then a further dramatic decline in 1986 when the remaining fertiliser subsidies were removed (OECD, 1998). Agri-environmental issues are now specifically targeted through environmental legislation and not agricultural policy measures. This subjects agriculture to the same environmental standards as those applied to other economic activities and reinforces the application of the polluter pays principle.

increase and any potential innovative adaptations to these developments will be stifled. Similarly, if an agricultural policy is implemented in order to encourage a particular behavioural practice, it is less likely its desired goals will be achieved, or only at considerably more cost, if support measures are left in place which encourage countervailing behaviour.

2.3. ENERGY

2.3.1. Current support levels and trends in OECD Member countries

The overall levels of support to energy in OECD Member countries appear to have decreased significantly in recent years. Unfortunately, estimates for energy support levels are generally scattered and incomplete. The exceptions to this are the coal producer subsidy equivalents (PSEs) which the International Energy Agency calculates annually for a selection of coal-producing countries. According to these, levels of support to the coal industry in five OECD Member countries have fallen from a peak of US\$16.4 billion in 1989 to an estimated US\$8.1 billion in 1995. However, as shown in Table 2.2, this development is primarily due to consistent reductions in a few countries, particularly the United Kingdom, while others have less clear trends or have shown increases in support levels.

Energy subsidies in OECD Member countries are primarily used to support producers, often through the application of market price support mechanisms. Although market price support for West European hard coal producers has been decreasing since its peak of approximately US\$5.5 billion in 1989, it was still over US\$5 billion in 1992, with West European consumers continuing to pay roughly

Table 2.2. **Producer subsidy equivalents for coal in selected OECD Member countries, 1982-1996**

In constant 1990 billions of US\$													
	1983	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996 (p)
Germany	3.7	3.9	5.0	6.9	7.3	7.1	7.0	6.8	7.5	6.2	5.5	6.2	5.6
United Kingdom	4.0	2.4	2.7	3.8	5.3	7.4	2.2	1.9	1.8	0.3	0.2	0.2	n.a.
Spain	n.a.	n.a.	0.4	0.8	0.9	0.7	0.6	0.7	0.7	0.6	0.8	0.9	1.1
Belgium	0.3	0.4	0.4	0.4	0.2	0.2	0.1	0.1	0.1 (p)	n.a.	—	—	—
Japan	1.0	1.3	1.3	1.4	1.3	1.0	0.9	0.8	0.7	0.9	0.8	0.8	n.a.
Total PSEs for selected countries	9.0	8.0	9.9	13.2	15.0	16.4	10.7	10.3	10.7	8.0	7.3	8.1	6.7

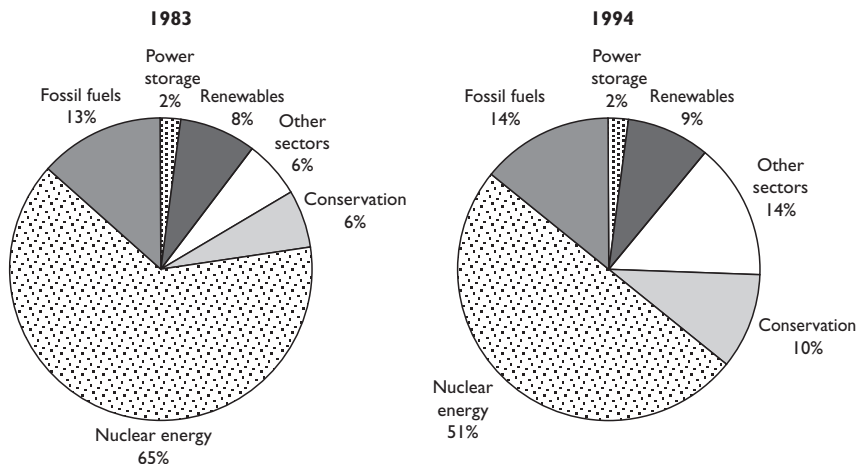
n.a.: not available; p: preliminary.

Sources: IEA (1991, 1992, and 1997).

double the world market price (Steenblik and Coroyannakis, 1995). Even these high government-brokered domestic prices did not cover the full private costs of production, often leading to the use of a range of other government support measures as well, such as deficiency payments paid to producers for sales below their production costs. The IEA estimates that budgetary transfers from European Union treasuries for such payments amounted to US\$4.5 billion in 1992.⁸ One report estimated that cross-subsidies in energy amount to a minimum of US\$7 billion per annum, with cross-subsidies found both between different consumer groups and from low-cost to high-cost producers within the industry (de Moor, 1997).

Direct support measures to different fuel types and support to research and development have been biased in favour of coal and nuclear power. It has been estimated that support to nuclear and fossil fuel power constituted a total of 75 per cent of direct support to energy in the European Union over the period of 1990-95, while support to conservation, renewables and electricity account for the remaining 25 per cent (Ruijgrok and Oosterhuis, 1997). Even though shares of research and development funding have been moving away from nuclear power and fossil fuels in recent years, these still make up the bulk of support (Figure 2.3). Total IEA government funding to research and development has declined

◆ Figure 2.3. *Aggregated IEA government funding for energy research and development, 1983 and 1994*



Source: IEA (1996b).

Table 2.3. **Average taxes on different fuels in 1995 in the OECD**

Price per barrel of oil equivalent in US\$

Natural gas	Oil	Coal
1.3	22	0.3

Notes: – In many countries the natural gas prices are set administratively, so the average tax listed here is only a rough indicator.

– The average tax rate for oil includes taxes on transportation oil.

Source: IEA, *Energy Prices and Taxes*.

over the period, to a level of approximately US\$10 billion in 1994. In addition to the government-funded research and development, the European Commission also undertakes a substantial energy research and development programme, which cost approximately US\$356 million in 1993 (IEA, 1996a).

In addition, a number of studies have drawn attention to the unequal incidence of fossil fuel taxes. In most countries, these taxes tend to fall most heavily on the cleanest fossil fuels and least heavily on coal, as can be seen in Table 2.3 below.⁹ These differences are primarily because the taxation has been imposed with the intention of raising revenues, not to internalise environmental effects. As a result, we find that coal, which is the most polluting fossil fuel, is taxed the least in actual practice.

Reform of German coal subsidies

Germany has historically provided significant support to its domestic coal industry. In 1990, total assistance per coal miner was estimated to be US\$90 200 for West Germany – several times a miner's annual wage (Anderson, 1995). The support served both to deter cheaper coal imports and to ensure artificially high shares of coal were used in electricity generation, often through the use of minimum local-purchase agreements with electricity generators. Thus, German electricity utilities agreed to buy at least 87 per cent of their coal needs from local mines during 1992-1995, with three quarters of it priced at twice the price of imported coal (Anderson and McKibbin, 1997).

In recent years, Germany has committed to significant reductions in coal producer support. Thus, in 1992 the German government prepared a plan to limit support to a maximum of 20 per cent of total energy demand in 1995, and 15 per cent by 2000 (ECON Centre for Economic Analysis, 1996). Then, on 13 March 1997, it was further decided that total support would be decreased from DM 9.25 billion in 1998 to DM 5.5 billion in 2005.

Another form of implicit support to energy producers is the existence of government-brokered long-term obligations by electricity generators to use specified domestic fuels. These generally favour the coal industry and reduce the relative competitiveness of alternatives, including both the use of other fuel sources and the reduction of total energy consumption. Minimum local-purchase obligations for coal can prevent high energy prices from being translated into lower volumes of coal consumed (Steenblik and Coroyannakis, 1995). Policies which favour particular fuels also tend to distort decisions regarding government-funded research and development, perpetuating a cycle of support dependency. As a result, competition from alternative fuels and new technological developments is stifled.

2.3.2. Policy reform

In May 1987 the Governing Board of the International Energy Agency, meeting at Ministerial level, called for the reduction and eventual elimination of barriers to energy trade. Since then, the primary focus of the energy policy debate in IEA countries has been about the restructuring of the electricity supply, though few countries have actually undertaken substantial reforms to date. The recognition that the generation of electricity is not a natural monopoly, unlike its transmission and distribution, has led to attempts to unbundle these three components and the provision of rights of access by third party generators to electricity transportation and distribution grids. In 1992 the European Commission proposed rules for a liberalised internal electricity market. Under pressure from Member States, the final directive has watered down the third party access requirements. A number of other OECD Member countries, including the United States, Australia, New Zealand, Norway and Japan have also made substantial moves towards electricity deregulation recently. Preliminary results indicate that competitive markets can work efficiently and provide for new capacity at lower cost.

Germany has taken significant steps in committing to a reduction in its massive coal supports in the last few years. The United Kingdom has already been rapidly phasing out coal support, with the co-operation of the newly privatised electricity industry. There are still some price protections that remain, but most will end in 1998 (ECON Centre for Economic Analysis, 1996). Both Belgium and France decided to phase-out coal production, with Belgium's last mine stopping production in 1992 and France due to finish in 2005. Japan decided that the 1990s would be the final stage of providing structural adjustment assistance, including subsidies, to their coal mining industry.

Deregulation of natural gas markets and the promotion of competition is also moving ahead in several OECD Member countries, though generally at a slower pace than the deregulation of electricity. The most advanced examples of gas

deregulation are to be found in North America, with the liberalisation process almost complete in Canada. In the European Union, deregulation of gas markets has been slower, largely because of internal disagreements on the reforms that are necessary in order to complete the single market. The United Kingdom proves the exception, with third party access to the pipeline system and competition in much of the industrial sector already in place.

2.4. TRANSPORT

2.4.1. Current support levels and trends in OECD Member countries

There are no available calculations of the levels of aggregate support to transport usage, largely because of the complexity and range of transport charging systems and expenditures. In general, road-related taxes have been on the increase in most Member countries. This often reflects an attempt to recover the costs of infrastructure and road-services as well as the external effects of road usage, rather than merely to raise government revenues on a relatively secure tax base. However, there are indications that, despite these rising taxes and charges on transport activities, governments continue to support the provision and usage of transport systems. If the provision of transport infrastructure, maintenance and services are provided below cost,¹⁰ transport-related activities are supported and the markets for these activities distorted. Government regulations can also lead to significant cross-subsidies between different transport users or transport users and non-users.

In place of a comprehensive measure of aggregate support to transport¹¹ some studies have compared total transport related revenues to direct expenditures in order to indicate the magnitude of support to the sector. Most of the available material has focused on road transport, largely because it is the primary transport mode in OECD Member countries, accounting for an estimated 93 per cent of all inland passenger-kilometres and 76 per cent of all tonnes of freight kilometres in ECMT countries¹² in 1995 (ECMT, 1997).

One OECD study (1987) on the public and private financing of road infrastructure found that a number of OECD Member countries do not cover total road expenditures through road-related revenues. Several other countries were found to more than cover total road expenditures, sometimes with a significant net revenue. This difference can partly be explained by the fact that some compared only current account expenditures, and did not include capital accounts. It is also partly attributable to the fact that some countries implement additional road-related environmental taxes and charges to partially or fully recover the estimated costs of externalities. For a more informative comparison, the estimates of external costs should be included on the expenditure side so long as the relevant taxes are included in the calculations of revenues. The effect on the revenue-to-

Table 2.4. **Road transport cost coverage with and without the external costs taken into account for selected OECD Member countries, 1991**

	France		Japan Total	USA Total
	Urban	Rural		
Revenues as % of costs	129	164	82	80
Revenues as % of costs including external costs	42-57	92-105	66	64

Notes: – Definitions and methods of calculating external costs varied between countries.

- Because of uncertainties embedded in the calculations of external costs, both the French and the US data cited upper and lower bounds for estimates, though for the US ratio there was only a difference of 0.17 per cent.

Sources: Haltmaier (1997), Morisugi (1997) and Orfeuill (1997).

cost ratios for three OECD Member countries of including estimates of the costs of road externalities (such as air and noise pollution, greenhouse gas emissions and those accident costs which are not covered by insurance) can be seen in Table 2.4. Adding the estimates for transport externalities to the cost side of the revenue-to-cost ratios significantly reduces the ratios, indicating that a larger (or any) net subsidy does accrue to road users. In addition, the different ratios for French urban and rural road users highlights the significance of cross-subsidies from rural to urban users.¹³ Both the French study and a UK study also indicate that there are substantial cross-subsidies between different vehicle classes, with car and light truck users often supporting heavy truck users (OECD, 1992b and Orfeuill, 1997).

2.4.2. Policy reform

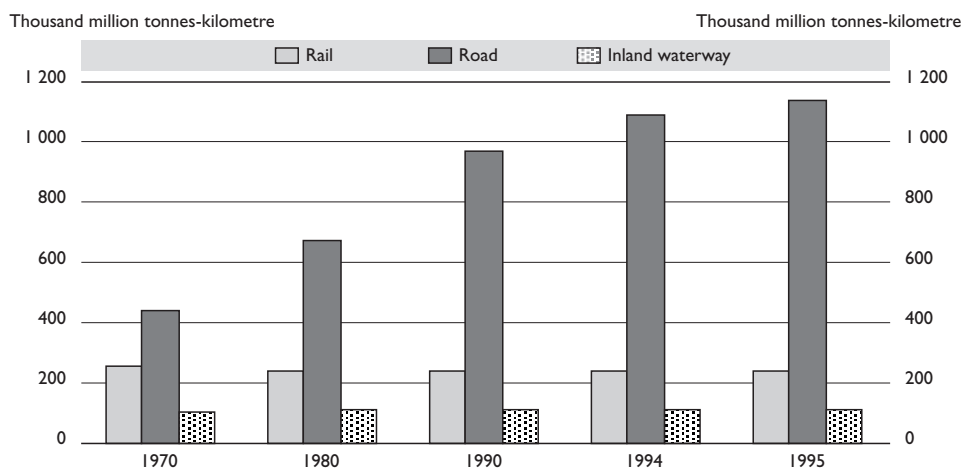
In recent years, transportation related taxes and user charges have been increasing both in an effort to internalise the full costs of transport activities and to raise revenues as, particularly for passenger road uses, transportation demand is relatively inelastic in response to price changes in most OECD Member countries and so makes a useful tax base. Demand for road freight transport is more price-elastic, and is often cross-subsidised by passenger transport as a result.

The timing and structure of deregulation activities for different transport modes has had a significant effect on the relative competitiveness of the different modes over time. Freight transport in particular has historically been highly regulated, with rail services frequently provided by the government and road haulage often regulated to control the quantities of vehicles and ensure professional competence (OECD, 1997e). According to the Rome and Maastricht Treaties, the members of the European Union are required to implement a common transport policy under the principles of free trade and competition. However,

little action was taken in this direction until 1985 when the European Court of Justice ruled in favour of a suit brought by the European Parliament against the European Council for failure to implement a common policy. Some market liberalisation did take place as a result, but focused almost exclusively on road haulage. Comprehensive regulatory reform of the rail sector has only begun more recently. As a result, a strong and highly competitive road freight sector has developed in Europe, and has been able to continuously increase its market share of freight transport relative to rail and inland waterways transport, as can be seen in Figure 2.4. In fact, road freight transport has increased by just over 6 per cent per year since 1970, while there has been an increase in inland waterway freight of less than 0.4 per cent, and rail has decreased by 0.2 per cent per year.

In comparison, the liberalisation of freight transport systems in the United States started in the late 1970s and began with airline deregulation followed closely by both rail and road haulage. Because reforms took place in the different modes almost simultaneously, all modes were given the same incentives to reduce inefficiencies and improve quality of service in order to continue to be competitive. Through improved efficiency (for example, rail freight use of energy declined by 26 per cent between 1980 and 1993 while rail ton-kilometres increased 27 per cent) and the development of innovative new long-distance

◆ Figure 2.4. *Shares of freight transport to rail, road and inland waterways in the European Union, 1970-1995*



transport systems, rail freight transport in the United States managed to regain its pre-liberalisation market share after an initial decline (OECD, 1997f). As a result, the rail freight industry in the United States has successfully maintained its market share of freight transport, while it has been steadily declining in Western Europe.

In addition to liberalising transportation markets, a number of governments have also begun to internalise the social costs of transport into transportation usage prices. In the 1997 Helsinki Declaration, the European Council of Transport Ministers reiterated their support for the internalisation of the external costs of transport.

2.5. INDUSTRY

2.5.1. Current support levels and trends in OECD Member countries

The most commonly used measures to support industry in OECD Member countries are grants and tax expenditures which allow tax concessions to particular industries (OECD, 1996b). In addition to this financial assistance, governments of OECD Member countries have also had significant involvement in their heavy industries through ownership, regulation and trade measures. During the 1980s policy attention focused on the large government programmes that supported industry. These programmes were seen to contribute relatively little to structural adjustment programmes (if not actually hamper them), were a burden on the public budget and distorted national and international competition and trade. However, both the multiplicity of support measures used, and the variety of policy incentives and financing mechanisms they were built on, contributed to an increasing opacity of support and an ensuing difficulty in estimating and comparing total support levels.

As a result, the OECD undertook a three-phase project to survey support to industry over the period of 1982 to 1993 in order to raise the levels of international transparency and to compare the trends and patterns of public support at an international level. Over the course of the work a more standardised approach to industry support accounting was devised and, as a result, country reports for the final stage were much more comprehensive and comparable than the previous stages. Because of the differences in accounting procedures and the definitions of "support" that were used, the results found in the different phases are not strictly comparable, but the general trends can be discerned.

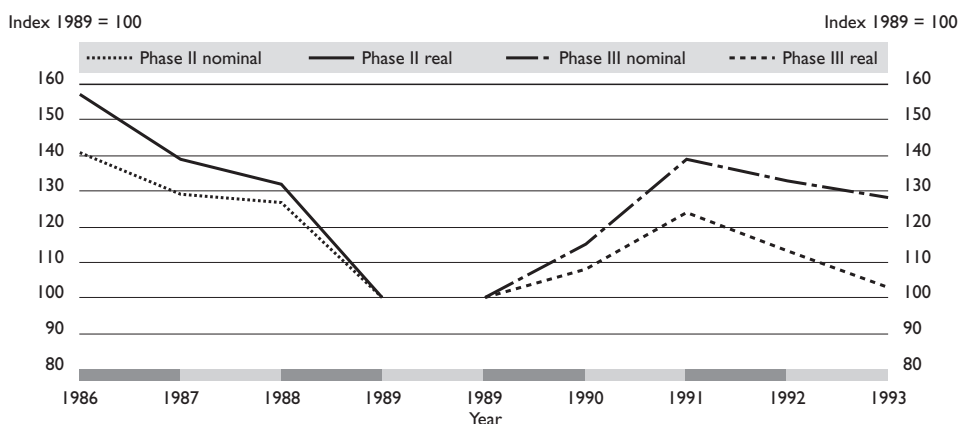
Throughout the 1986 to 1989 period (Phase II of the project)¹⁴ there was a continuous decrease in total reported support to industry by OECD Member country governments as calculated by the Net Cost to Government (NCG),¹⁵ with an average annual reduction of 9 per cent. By 1989 the total reported support to the manufacturing industry was US\$39 billion. This downward trend was then

reversed in 1989, and by 1991 total support had increased to US\$54.3 billion, before falling again to US\$49.3 billion in 1993. Figure 2.5 below shows the change in public support between 1986 and 1993 based on an index of 100 per cent for 1989 support levels. Because of limitations in the data available for 1992 and 1993 support expenditures at the time of the report, the estimates for these years are believed to be underestimates of the full support amount (OECD, 1996b). Part of the reason for this has been an increasing shift in industry support to the regional policy level.

While Figure 2.5 reflects the overall trend in government support to industry in OECD Member countries over this period, trends in support levels within countries have varied. For example, although total state support to the steel industry in the European Union declined by 29 per cent between 1986 and 1994, support in Spain fell by 87 per cent over this same period while support in Italy actually rose by 81 per cent (Verbruggen and Oosterhuis, 1998 forthcoming).

There have also been changes in both the financing instruments used to provide support and the policy objectives they are intended to fulfil. By the end of the 1980s, there had been a broad shift in expenditures away from general investment support, short-term crisis aid and subsidies for sectors facing overcapacity and structural problems and towards research and development, trade and support for foreign expansion. Furthermore, operational “decentralisation” of

◆ Figure 2.5. *Index of public support in OECD Member countries to the manufacturing industry, 1986-1993*



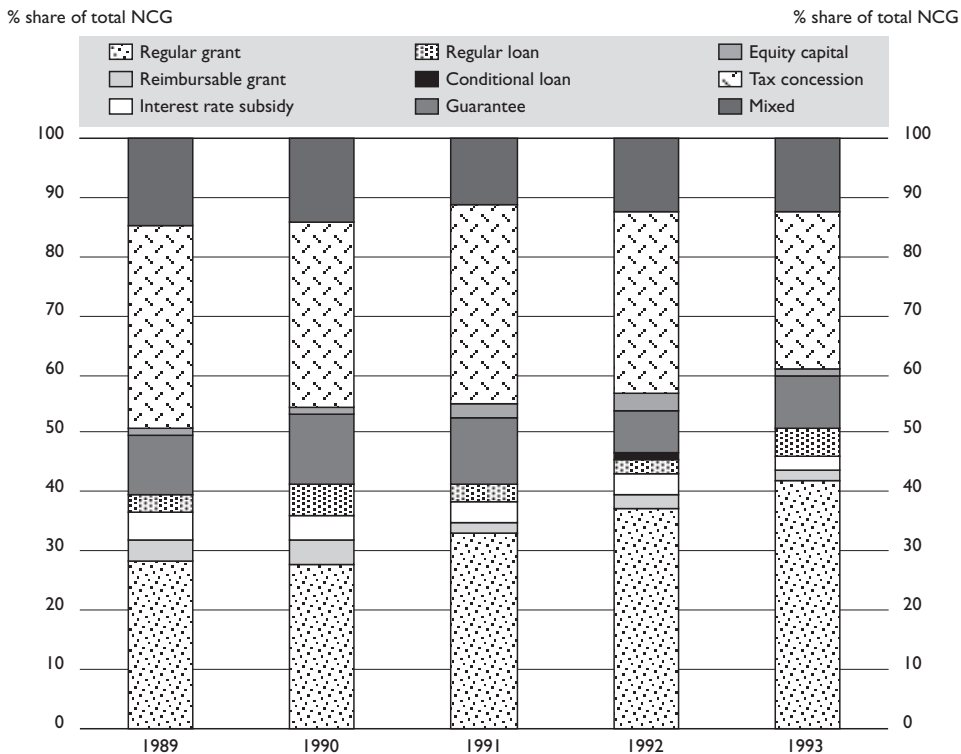
Note: Because of interphase comparability problems, only limited comparisons of the quantitative information from this project can be made. As a result, an index of public support is used to indicate trends in support between the two phases with the overlapping date of 1989 taken to be 100%.

Source: OECD (1996b).

government support shifted in some countries to regional policy and small-firm support, to improve out-reach to potential recipients of government assistance. Thus, an important trend that has been observed in the studies is the increasing shift in industry support to the regional policy level. Despite these trends, the major portion of funding in 1993 was still given through conventional subsidies rather than to research and development, innovation or small firms. Of the sector-specific aid provided, more than half was concentrated on three ailing industries – steel, shipbuilding and textiles – which together accounted for only 9 per cent of manufacturing GDP in OECD Member countries in 1993.

As can be seen in Figure 2.6, the policy instruments used to provide this support have varied over recent years, with few clear trends apparent. The share

◆ Figure 2.6. *Share of total NCG of support to industry as reported in OECD Member countries by financing instrument used, 1989-1993*



Source: OECD (1996b).

of support given through grants continued to rise in importance over the third phase of the project between 1989 and 1993, with grants and tax concessions remaining the most commonly used financing instruments for support over the period.

Swedish Energy Tax Expenditures to Industry

The Swedish taxation system has been characterised for a long time by both unusually high income taxes and high energy taxes. In 1991, the need for a major tax reform in order to cut marginal taxes and to finance the large budget deficit lead Sweden to significantly increase environmental taxes. These included the application of VAT to energy use and the introduction of excise taxes on carbon and sulphur. General energy taxes on fossil fuels were reduced, but the overall effect was to increase taxation.

While in principle these taxes applied to all energy consumers, in fact some industries were granted tax concessions under a 1974 law that ensured Swedish producers would not be disadvantaged relative to international competitors who faced lower energy taxes. The main beneficiaries of the policy were energy-intensive industries, for whom the government would “cap” their energy tax at a level of 1.7% of total product value. The tax reduction could, in some cases, be granted at the individual firm level, an impractical and expensive process that was open to possibilities of regulatory capture. In addition, because tax exemptions were granted to the most energy-intensive industries, the taxes were deemed to not have any incentive effect at all. As such, the European Commission argued that they were merely a fiscal arrangement, not the result of environmental or energy policies.

Harmonisation with EU taxes was sought because of these difficulties, and a much greater reduction in industrial energy taxes (and thus a reduction in the production costs faced by Swedish companies) was implemented. A 1993 tax reform led to a total exemption for industry of the energy tax, and an exemption of 75 per cent of the carbon dioxide tax for all industrial users. This cut was financed by an increase in taxes on domestic consumers. Since July 1997, the carbon dioxide tax exemption has been reduced to 50 per cent.

The primary argument in favour of the original tax concessions was the risk of competitive disadvantage that Swedish energy-intensive industries might face. However, given the relatively small amounts most energy-intensive industries would have had to pay under the 1991 energy taxes, it seems unlikely that these taxes would have been that damaging to these industries. Only the select dozen most energy-intensive companies have benefited significantly from the tax exemptions. However, instead of removing the tax exemptions and applying the same energy taxes to all industry, the government instead reduced the energy taxes for all industrial consumers.

Source: Sterner (1996).

It should be noted that the economic significance of the various financing instruments (and the demand for support) varies according to the business cycle and other economic circumstances, such as prevailing taxation rates. Moreover, these forms of support measures are often used as instruments to avoid unjustified hardships or alleviate distortions that otherwise would prevail as a result of normal taxation policy.

The share of support to industry that is provided through tax exemptions declined steadily over the 1986 to 1989 period, but this trend was less obvious in the 1989 to 1993 period. The OECD study (OECD, 1996b) found there was a general upward trend in the share of total support provided through tax concessions, although this trend was masked by the low reliability of the 1992 and 1993 reported data and the general difficulties of calculating tax concessions. It was not until the 1980s that most OECD Member countries started implementing systems for reporting tax expenditures, and both the frequency and coverage of reports continues to vary significantly between countries. Tax expenditures take a number of forms, including tax exemptions, allowances, credits, rate reliefs, rebates and deferrals, but classification of any statutory fiscal provision as either part of the normal taxation rate or as an exception to it can be difficult. Thus, although the choice of a benchmark norm is crucial for the identification of tax expenditures, there is often a lack of consensus on what an appropriate benchmark is for any particular tax base. As a result, methods of tax expenditure calculations vary between countries, are generally considered to be difficult to compare, and the tax expenditures themselves are frequently underestimated.

2.6. CONCLUDING REMARKS

2.6.1. Summary of trends and levels of current support in OECD Member countries

What data is available on support levels indicates that they are declining, but slowly. Other than for agriculture and coal production, however, internationally-comparable data on support levels are either scarce (such as for other forms of energy and industry) or almost non-existent (such as for transport and fisheries). Support to agriculture makes up the bulk of the quantified support in OECD Member countries, with total transfers associated with agricultural policies accounting for almost US\$300 billion in 1996. While this amounted to 1.3 per cent of total GDP in 1996, it was a drop from an estimated 2.2 per cent in 1986-88. Support to agricultural producers also fell, from 45 per cent of the total value of production in 1986-88 to 36 per cent in 1996 as measured by the percentage PSE. However, these decreases in total agricultural support may be somewhat misleading as the majority have taken place only recently and have largely been the

result of rapid GDP growth and high world prices, which have narrowed the support gap between domestic and world prices, rather than from policy reforms.

Support to energy probably constitutes the second most significant area of support in OECD Member countries, and the available indicators also show decreases in total energy support. For example, support to coal producers in a selection of OECD Member countries has declined substantially from almost US\$16.5 billion in 1989 to a provisional estimate of just under US\$7 billion in 1996. Support to industries in OECD Member countries also fell in the early 1990s, from a peak of US\$54.2 billion in 1991 to US\$49.3 billion in 1993. However, this trend followed a period of steeply increasing support between 1989 and 1991, and there are no strong indications of the trends in industry support levels since 1993.

Although aggregate support levels in OECD Member countries have generally been decreasing for all the sectors analysed, this trend can not be seen in all Member countries, and current levels continue to be high. Despite considerable international pressure for the reduction of support levels, a number of individual countries are increasing total support levels, sometimes quite substantially and with no indication of an intention to reverse this process. In addition, levels of total existing support vary considerably between member countries with, for example, three countries estimated to be maintaining producer subsidy

Table 2.5. **Developments in selected support levels and in selected countries**

Support to	1986-1988 ^a	1989	1991	1993	1995	1996	Remarks
Agriculture							
Total transfers	279	264	332	337	333	297	US\$ billion
	253	239	269	287	255	234	ECU billion
Total transfers as % GDP	2.2	1.8	2.0	1.9	1.5	1.3	As % of production value
Percentage PSE ^b	45	37	42	42	40	36	
Coal production	13.2	16.4	10.3	8.0	8.1	6.7 (p)	Total PSE ^b in Germany, UK, Spain, Belgium and Japan (US\$ billion)
Industry^c		39.0	54.2	49.3			Reported net government expenditures in OECD Member countries (US\$ billion)

p: preliminary; coal PSE estimates for the United Kingdom and Japan for 1996 were not available for this aggregate estimate.

a) 1987 for coal production statistics.

b) Producer subsidy equivalent: a measure of the value of the monetary transfers to producers resulting from policies in a given year, including transfers from both consumers and taxpayers. The percentage PSE is the gross total PSE expressed as a percentage of the value of production.

c) The estimates of support to industry may overlap to some extent with other support estimates, e.g. to energy.

Sources: Agriculture: OECD (1994, 1996e and 1997d); Coal: IEA (1991, 1992, and 1997); Industry: OECD (1996b).

equivalents to agriculture under 10 per cent of total production value in 1996, while three others had PSEs of over 70 per cent.

Market deregulation, particularly with respect to energy and transport markets, can complement financial support reductions by increasing competition. If support reductions are undertaken without the accompaniment of regulatory reforms, their effectiveness will generally be reduced. So long as other protectionist policies are maintained, reductions in government financial support may simply be replaced by increased prices to consumers, thus entailing an increased transfer of support from consumers to producers. In recent years, a number of Member countries have undertaken comprehensive liberalisation of their energy and transport markets with the purpose of reducing government financial support and increasing the efficiency of these sectors through making them more responsive to market signals.

Support to agricultural production has been moving away from market price support and other support measures coupled to input and output levels and towards direct income support. Support which is decoupled from production and input decisions in this way does not have the same built-in incentives to expand production and input use (with their associated levels of environmental damage), although it still manages to maintain farm income levels.

The shares of research and development support that are allocated to various energy sources and conservation is also changing in a more environmentally-beneficial direction, although rather slowly. Thus, the share of total energy research and development support in OECD Member countries that was allocated to energy conservation rose from 6 per cent to 10 per cent between 1983 and 1994, while for renewable energy sources it increased marginally from 8 per cent to 9 per cent.

By reducing the market prices of goods (especially materials and energy) or increasing the revenues of industries that provide them, support stimulates high levels of resource use and wasteful production processes, making materials and energy saving less profitable. Therefore, any support measure that lowers the user costs of resource use, rather than encouraging a reduced or more efficient use of the resource, will contribute to higher volumes of inputs, throughput and, as a consequence, pollution. These will then need to be countered, often at additional cost, through stricter environmental policies. Reducing a support measure that encourages the increased intake of materials and energy is likely to also reduce the costs of environmental policy implementation.

2.6.2. Interpretation of results

While estimates of producer subsidy equivalents (PSEs) and consumer subsidy equivalents (CSEs) have been calculated for agricultural support in the

OECD, and PSEs for coal support, little other comprehensive and comparable data exists on support levels in OECD Member countries. The PSEs and CSEs have proven a useful system for calculating estimates of support levels that can be used to both analyse trends in support within a country and between countries. They are fairly easy to calculate and require data that is readily available in most countries. However, because they use a static, partial-equilibrium framework, they cannot measure either the net economic or welfare costs of assistance or the gross savings that would be realised if protection were removed. Instead, a dynamic simulation would be required to generate this information. In addition, primarily because of data collection limitations, the share of actual agricultural production that is covered by PSE data varies from country to country. Coverage of some policies, particularly with respect to tax concessions, sub-national and agri-environmental measures, is particularly uneven.

Although these statistics may be easy to calculate arithmetically, determining the appropriate reference levels for support is more difficult, largely because of the range of measures used to provide support and the variety of definitions of support that can be applied. A primary problem is the determination of an appropriate “normal” reference price against which to calculate support levels. For example, there is considerable debate over the appropriate value added tax level for domestic energy consumption. Some propose that the reference level should be the same as standard consumption goods, while others suggest a lower tax rate should be applied, as domestic energy can be considered a necessity. Depending on which reference level is used, the estimate of energy consumption tax expenditures will vary significantly. Similarly, there is no widely-accepted reference system with which to calculate internationally-comparable tax expenditures to industry.

The difficulties experienced in calculating total support levels are compounded in any attempt to identify and quantify the environmental effects such support might have. While fiscal data are scarce and often incomparable, accurate environmental data is often even more difficult to find. Where such data does exist, the connections between the two are poorly understood and influenced by a variety of other factors. It is often difficult to disentangle the effects of support from what would happen were the support not in place. As a result, general trends and orders of magnitude of the effects of support measures on the environment are often all that can be determined.

3. IDENTIFYING FACTORS THAT DETERMINE THE ENVIRONMENTAL EFFECTS OF SUPPORT MEASURES

3.1. SEPARATING THE ROLE OF SUPPORT MEASURES FROM THE INFLUENCE OF OTHER INCENTIVES AND FROM THE SURROUNDING CIRCUMSTANCES

In order to assess the environmental effects of support reduction, it is necessary to disentangle them from the influences of the surrounding circumstances, incentives and obligations that can serve to reinforce or counteract these effects. These influences include characteristics of the markets in which the support recipients operate, the government policies in place (particularly regarding taxation and environment), and autonomous technological and economic changes. In fact, there are generally so many factors (and actors) involved, and their interaction can take so many forms, that no one support measure is exactly like another. Each support scheme has its own peculiarities, making it very effective under some circumstances and ineffective under others. Nevertheless, there are three key factors that have been identified as determining the environmental effects of support measures:

- *the level of protection from competition that support measures offer the recipient sector – i.e., to what extent alternatives to the recipient sector are discouraged;*
- *the environmental effects of the alternative products or technologies that are discouraged by the support measure, compared with those of the supported sector; and*
- *the circumstances that determine how sensitive the environment is to the particular change in emission or waste levels brought about by the support measure.*

These factors highlight the division between what governments can change, such as support measures themselves and, to a lesser extent, the emergence and the use of cleaner technologies; and what they cannot influence, including the dose-response relationships that determine the effects of a particular emission on environmental quality. In order to arrive at any policy conclusions about support measures, it is therefore important to separate the effects of the support measure itself from the effects of other incentives and environmental circum-

stances. The complex linkages between support measures and environmental damage will now be examined in context.

Effects on production levels

The first question of interest is to what extent a support measure *affects the composition of production in the economy*. This is referred to as *linkage 1* in the following. The composition of production includes the production levels of the various branches of industry which produce consumer goods and all the intermediary products that serve as inputs to other stages of production or industries, such as capital goods, ores, materials, fuels, water, fertiliser, etc. The effect of a given level of support on the composition of production will depend on various factors. These will be briefly discussed below, but the discussion will necessarily be based on many simplifications. There will often be exceptions to the generalisations presented here (mainly due to variations in particular circumstances) but the majority of support measures will work as outlined below.

Effects on the actual emissions and resource depletion levels

The degree to which a change in the composition of production will lead to a change in the levels of pollution and waste will depend, among other things, on the existing environmental policies. If support leads to the expansion of sectors in which total emissions are kept within strict limits by environmental policy, the actual emissions may increase by only a small amount, if at all. On the other hand, such an outcome would necessitate the continuation or expansion of strict environmental policies, which would have associated costs. Assessing the costs and benefits of support usage should take into consideration the costs of any necessary increases in environmental policy enforcement costs. When it comes to assessing the environmental damage, however, only changes in actual emissions are important. This distinction is made in *linkage 2*, which measures the emissions that result from a volume of activity, excluding those “filtered” by environmental policies. There is an important policy choice involved: governments can choose not to reduce support and incur a higher level of environmental expenditure – either through increased environmental policy enforcement costs or increased environmental damage – or to reduce the support and reap savings in environmental policy enforcement or clean-up costs. The effects on environmental expenditures will, in turn, affect other relative costs and prices in the economy, and thus feedback on the conditions in which the support measure operates.

In situations where there is a risk of the over-exploitation of natural resources – such as with overgrazing, overfishing, or the excessive use of groundwater-fed irrigation water – similar policy choices are necessary. Governments can choose to curb the level of activities that lead to over-exploitation of the natural resources,

either by reducing their use directly (or the need for them in the future) or by leaving the problems to be confronted in the future when these natural resources will be available only at (much) higher costs.

Effects on environmental quality

The degree to which increased emission levels or resource depletion leads to actual environmental damage depends on dose-response relationships, indicating the assimilative capacity of the recipient environment (*linkage 3*). These factors may be highly site-specific, particularly when the emissions have predominantly local or regional effects. In such cases, it is often virtually impossible to draw general conclusions about the potential environmental damage that would be caused by increased emission levels, even at the country level. In the case of pollutants that have global effects (like CO₂ emissions or CFCs), however, the effects are not site-specific and general conclusions can be drawn.

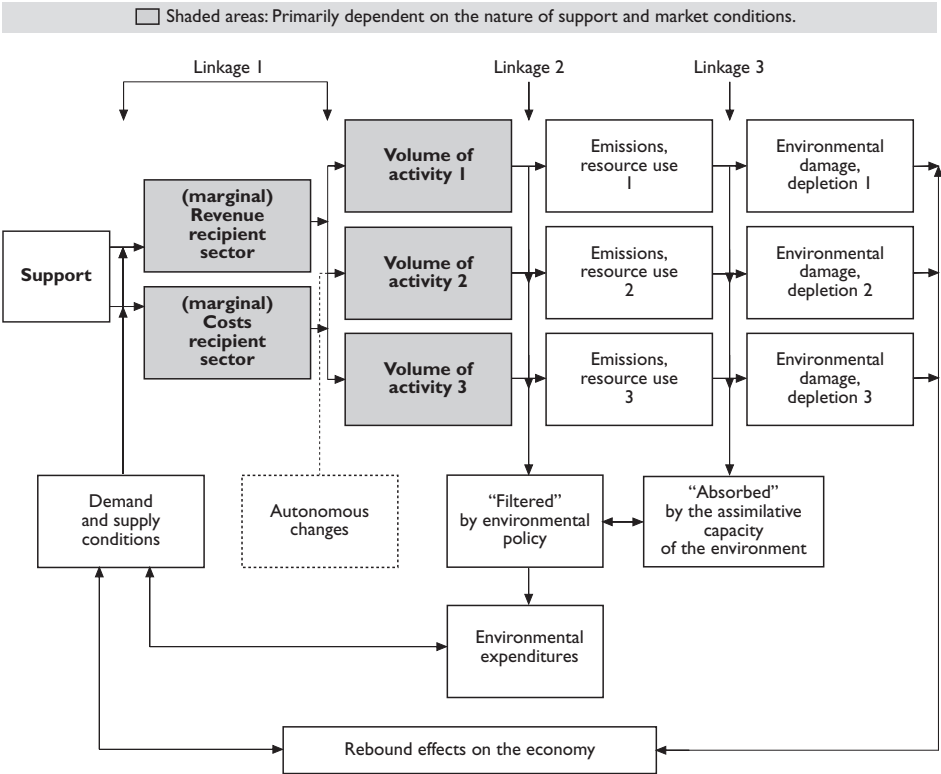
Environmental degradation and over-use of natural resources have “rebound” effects on the economy by changing demand and supply conditions. These effects have not been examined in the case studies under review, but their effects can be large. An example is open-access fisheries, where overfishing of the resource can lead to a decline in the viability of the sector itself. The OECD is preparing a study on the contribution of support to the depletion of fish stocks, updating data on support measures and analysing the incentives various elements of support schemes have on the level of catches. In coastal waters, the potential for environmental damage caused by support to fishing can at least be mitigated to some extent by policies that restrict the amount of fish that can be caught (for example, individual transferable quotas – ITQs) and the gear and methods that may be used to catch them. However, support that expands or upgrades domestic fishing capacity creates incentives for non-compliance with sustainable management measures. Furthermore, such capacity can still end up spilling over to the high seas, where most fisheries are unregulated, or into the exclusive economic zones of countries with poorly developed and enforced fisheries management systems.

The three linkages between support measures and their environmental effects are illustrated in Figure 3.1 below.

3.2. UNDERLYING FACTORS

For a given support measure, in principle all that is required to analyse its effects – or the effects of its removal – on the environment and the economy is data on the sensitivity of supply and demand to price changes (the price elasticities of demand and supply) on the relevant markets. Focusing on the relevant elasticities can help to more easily identify the support measures to be pri-

◆ Figure 3.1. **The linkages between support and the environment**



Note: As with all analyses, results will be dependent on the chosen assumptions, methodologies and available data such that quantitative results will always be subject to some degree of uncertainty.

Source: OECD.

oritisied for reform or removal. In order to do so, it is necessary to first look at how effective the support is in changing the composition of production of the entire economy, *i.e.*, what effect it has on the *relative prices and incomes*. For small, open economies, these elasticities are strongly dependent on world market conditions. Applying a subsidy which decreases the costs of production to below world market prices may incite a strong increase in demand for the product from abroad, resulting in a volume response (increase in production) to the price change that is much larger that would have been the case if limited to a closed

economy. Conversely, if the domestic supply costs rise above world market levels, foreign competitors will enter the domestic market, also leading to much larger volume response to the price increase – but this time in terms of a larger *decrease* in domestic production – than would occur in a closed economy. This complication is ignored in the description and graphical presentation presented below which show how support measures influence prices and recipient incomes as well as volume responses in a closed economy. In devising policy measures, however, due attention must be given to the degree to which the volume responses to price changes will increase if foreign suppliers and customers enter the market.

The role of price elasticities of demand and supply in influencing the price, income and volume responses to a support measure will differ depending on the type of support applied. Here a distinction must be made between support that

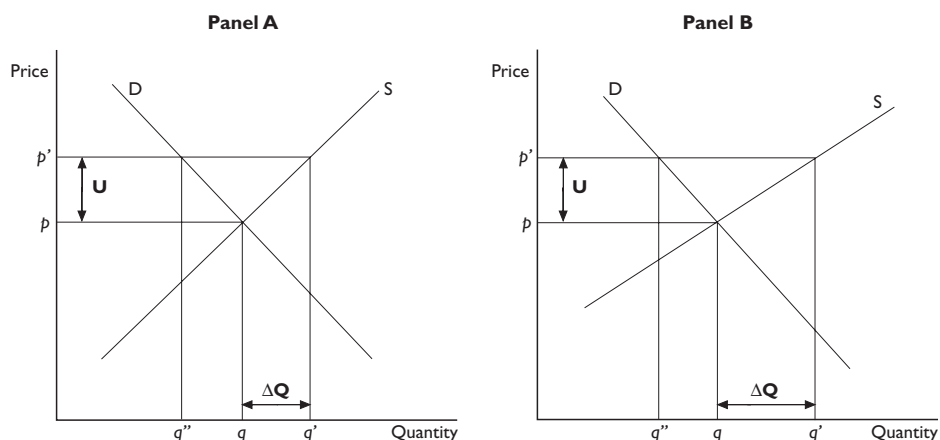
- *increases the marginal revenue of a sector through market price controls;*
- *decreases the costs of production, contingent upon the use of a particular production process or the purchase of a supported input; and*
- *accrues directly to income but is neither contingent upon input use or production levels.*

3.2.1 **Support that increases the marginal revenue of a sector by market price regulations.** For example: Minimum price support and accompanying measures

Effects on the output market

Market price support is typically provided through minimum price support and the accompanying regulations that guarantee minimum sales levels, such as import and export restrictions, purchase obligations, or both. These measures support producers by ensuring a market price for the product that is above the market price that would have prevailed in the absence of the support. Figure 3.2 gives a simplified representation of how such support works in a closed economy.

Market price support measures, as they are predominantly used in agriculture, effectively fix the price of the supported (agricultural) products above the level that would prevail in the absence of the support. The primary stated objective of these measures is to *support the incomes* of the producers (farmers). Market price support of this type usually consists of two parts: the transfer from users/consumers to producers through the higher prices they pay for the products, and the money spent by governments to ensure any excess production is bought that results from fixing higher prices for the products than those that market clearance would dictate. In return, the government often acquires a quantity of produce that must be stored, sold on the world market or otherwise prevented from re-entering the domestic market. Selling the produce on the world market, often at prices

◆ Figure 3.2. **Revenue raising support in a closed economy****Key**

D is the demand curve, S the supply curve, p is the price before and p' the price after a minimum price regulation is introduced. U is the difference between the two prices (i.e., the support). The quantity produced before and after the minimum price regulation are q and q' respectively, and the difference between the two is ΔQ .

q' can also be interpreted as the quantity the government wants the sector to produce. In order to ensure the recipient sector does not lose money by producing this quantity, a minimum price equal to p' is necessary. In order to ensure q' can be sold at this price, however, additional measures will be used to guarantee the purchase of the extra quantity ($q' - q''$) which will not otherwise be in demand at this price. Such measures may include government-brokered minimum domestic purchase agreements, support to sell the extra quantity on the world market, or government purchase and disposal.

Source: OECD.

below world market price levels, is often the least cost option for governments. In a number of cases, governments have also implemented maximum production quotas in order to limit the costs associated with taking the excess products out of the market. Market price support policies are often applied together with other support schemes that reduce the producer's costs.

For a given demand curve, a shallower supply curve (reflecting a larger price elasticity of supply) will yield larger volume effects to a certain change in price compared to a steep supply curve.¹⁶ This can be seen by comparing Panel B with Panel A in Figure 3.2. With the larger quantity of production, and assuming the same technologies, there will be more associated waste and pollution with the shallower supply curve. This will, of course, aggravate the government burden of addressing environmental problems. In addition, there will be a larger quantity of

“excess” product for the government to purchase or take responsibility for its disposal by some other means. In general, supply levels will respond more to changes in price in the longer run (*i.e.*, there will be shallower long-term supply curves than short-term ones). Figure 3.2, therefore, shows how there may be a tendency with market price support measures to require increased environmental protection expenditures over time in order to achieve the same environmental objectives.

Market price support measures are also often used by governments to *fix a certain quantity of production* and to ensure that this quantity is sold at a price that will ensure the producers achieve a given level of revenue. This is often used to ensure a desired level of employment in the supported sector, such as with coal mining. It often requires obligations by the consumers of the supported product to purchase particular minimum quantities at specified prices. In such cases, the government generally does not have to purchase quantities of the product to prevent them from re-entering the market, as the quantity to be purchased by the consumer is usually agreed contractually.

Regardless of the motivating factor – whether to support producers’ incomes or to fix a certain quantity of production – both types of market price support have strong effects on international trade. The higher levels of domestic production that are guaranteed tend to block cheaper imports or lead to an excess level of production – with the excess often sold abroad by the government at prices below the prevailing world market price. A graphical illustration of the effects on trade can be found in Annex 3.

Effects on downstream markets

The higher prices at which the products of the supported industries are sold will generally put downstream industries at a competitive disadvantage. In order to limit the negative effects on the competitive positions of the downstream industries, there is often a tendency to support them as well, thus leading to a chain of (expensively) supported industries.

Effects on the (upstream) input markets

Volume effects: Market price support increases domestic production above the level that would otherwise prevail. The increase in volumes of production will require a corresponding increase in inputs. The quantity of extra inputs that will be required depends on the *marginal productivity of the relevant inputs*. The marginal productivity of inputs often decreases as output expands, at least in the short run, leading to increased input requirements per unit of output. This, for example, is often the case with the use of irrigation water in agriculture. Where this does occur, it will generally lead to an increase in the associated potential emissions

per unit of output. Often, the marginal productivity of the resources can be enhanced by adjusting the production process. But this may require further investment and time.

Price effects: The increased demand for inputs will sometimes push up the prices of the required inputs. In the short run, this price response will depend only on the price elasticity of supply of the required input. In the longer run, the producer may adapt the production process to economise where possible on those inputs whose prices have risen, decreasing demand for these inputs and possibly increasing demand for others which are now more cost-effective.

Leakage effects

Some of the total amount of support given to a particular sector through market price support will “leak” away to the input suppliers, rather than staying with the intended recipient. This leakage will consist of two components: the extra volume of the input that is purchased in order to achieve the higher output levels, and the increase in the price of the input that results from the increased demand. This leakage effect can be substantial. For example, it is estimated that as much as three-quarters of total agricultural price support given may leak away from the intended recipients – primarily to input suppliers (OECD, 1995). As a result, market price support is clearly a very cost-inefficient means of achieving the objective of increasing farm incomes.

Decisive factors

In the short run, the factors that will be decisive in determining the income effects of market price support on the recipient producing sector will be

- *the extra income from increased sales (determined by any price or quantity regulations used or the price elasticity of demand); and*
- *the extra costs that result from the increased input requirements (determined by the characteristics of the production process and the price elasticity of supply of the required inputs).*

In the longer run, technological responses that increase the marginal productivity of the inputs will boost total production relative to input requirements. Accordingly, in the case of minimum price regulations, production at a given price will generally increase over time, necessitating government intervention to ensure the purchase of the extra production in order to maintain the specified prices and quantities.

3.2.2 Support conditional on the purchase of a product or the use of a particular production process. *For example:* Support to inputs, lump sum support to fixed capital, special low(er) rates of taxation conditional on inputs (*e.g.*, fuel).

Introduction

Support that is tied to the purchase of particular plant or equipment (support to fixed capital) will reduce the average costs of production. If the equipment is linked to a production process that is particularly polluting, this support may lock-in the technologies used in this process and inhibit any potential technological developments that might have resulted in a less environmentally-damaging process. If the support does not lock-in the use of a particularly polluting substance flow, the environmental effects of the support measure will be likely to be less significant than support that is tied to production levels or the use of particularly polluting variable inputs. In some circumstances, support to capital may not necessarily lead to an increase in the polluting substance flows, thus having no significant environmental effect.

Support to the purchasing of a particular input can consist of government provision of the input (such as is sometimes the case with irrigation water), preferentially low rates of normal taxation, or tax concessions or credits based on the use of a specified input. Regardless of how it is administered, support which is based on the use of a particular input will reduce the user costs of the input in the production or consumption process. The motives for such support can be either to support the producers of the supported input or its consumers. Either way, it will be shown below that some of the support will generally go to the producers and some to the consumers of the product, rather than solely remaining with the intended recipients. The extent to which some of the support will “leak” away to the non-target sector will depend critically on the market conditions for the input, particularly the degree to which demand and supply for the input are sensitive to price changes. The effects of different price elasticities of demand and supply on how the support will affect *prices, leakage effects* and *volume effects* is described below.

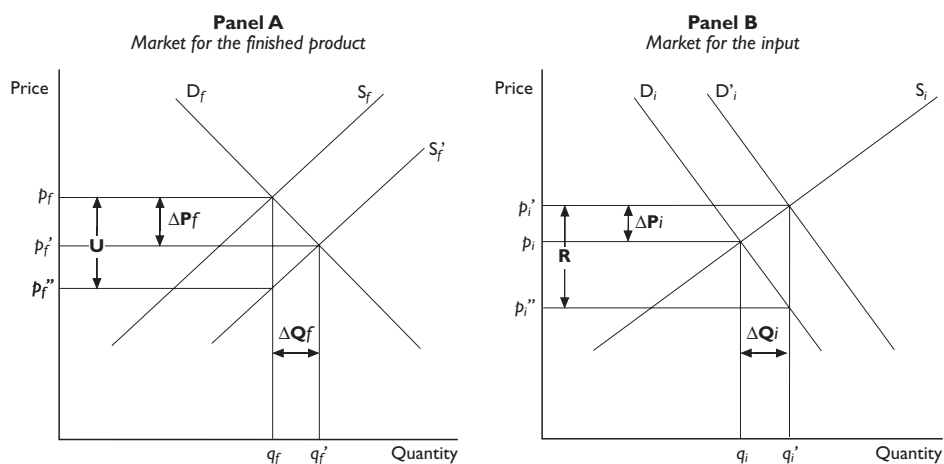
Effects on downstream and upstream markets

Price and volume effects on the market for the finished product (downstream effects): A producing sector that uses an input whose purchase is supported, for example through a tax exemption or reduction dependent on the consumption of the particular input, will realise lower marginal costs of production. As a result, this sector will be able to offer its finished product at a lower selling price than it otherwise could have. Or, if producers are price-takers and too small to affect world prices, they may expand production at the expense of imports. If a lower

selling price is offered, buyers will generally buy more of the finished product. But this increased demand for the finished good may push up the market price of the product, partly offsetting the price reducing effect of the support conditional on the input. This is depicted in Panel A of Figure 3.3.

Price and volume effects in the market for the input (upstream effects): The increased sales of the downstream product to consumers will increase production of the product, and so demand for the supported input. Where possible, the producer of the product may substitute the supported input for other inputs which are now less cost-efficient. These two factors will generate an increased demand for the

◆ Figure 3.3. **The price, leakage and volume effects in a closed economy of a support that is dependent on the use of a particular input**



Key

Both markets

D represents the demand curve, S the supply curve, p is the price before and p' the price after support, ΔQ is the change in volume produced. The subscript f denotes the market for finished goods and the subscript i refers to the input market.

Market for the finished product (Panel A)

U represents the downward shift of the supply curve due to support of the input ($p_f - p''_f$), S'_f is the new supply curve after the support, ΔP_f is the price change ($p'_f - p_f$) that is proportional to the amount of support that is leaked to the consumers of the finished product. The slope of S'_f is dependent on the slope of S_i , and thus the effects of support leakage to the input suppliers is already included in the after-support supply curve of the finished product market.

Markets for the inputs (Panel B)

D'_i is the demand curve for the supported input, ΔQ_i is the change in the quantity of the input used due to the expanded sales of finished products, R is the price effect on the input market of the shift to the right of the demand curve, and ΔP_i is the resulting change in the price of the input ($p'_i - p_i$) which is proportional to the support leakage to the input suppliers.

Source : OECD.

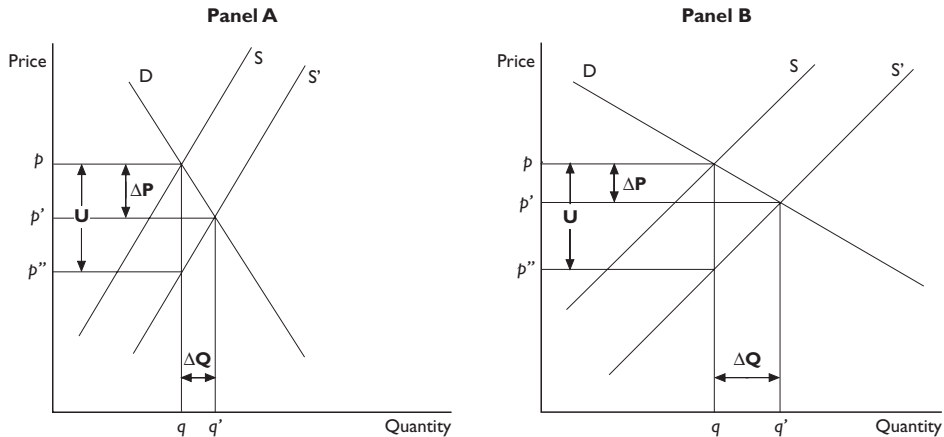
inputs, which will in turn force the sales price of the inputs up. Thus, some of the reduced input prices that result from the support to the input will be offset by price rises that can be maintained because of increased demand. This again will result in a reduction in the share of the support that accrues to the producing sector, as some is transferred to the input producer. Panel B in Figure 3.3 illustrates this transfer effect. Of course, the effects of the input market elasticities on input supply will be incorporated into the elasticity of supply of the finished product on the output market. Similarly, the effects of demand and supply in the finished product market will be incorporated into the producer's demand for the input as well.

Leakage effects: As a result, when support is conditional on the use of a particular input, the total support given will be divided between the supplier of the input, the producer of the finished product (the purchaser of the input), and the consumer of the finished product. A general equilibrium model would be needed to calculate precisely the relative shares each will receive for any particular support measure. However, a general rule can be developed for measuring the “*transfer efficiency*” of the support, comparing the changes in prices relative to the amount of total support in order to indicate support leakage to non-target recipients. If the objective is to support the finished-product producing sector, there will be a leakage of support to consumers as measured by any *reduction* in the price of the finished product, and a leakage to the input producers indicated by any *increase* in the price of the inputs. Conversely, if the intention is to support the input producer, any *reduction* in the price the inputs are sold at to the downstream producer will constitute a leakage of the support to this downstream industry.

Decisive factors: price elasticities of demand and supply

In general, the magnitude of the price, volume, and leakage effects of a support measure that is tied to input use will critically depend on the slope of the supply and demand curves. Figure 3.4 below illustrates this. Panel A of the figure depicts a market where supply and demand are both equally unresponsive to changes in price – *i.e.*, there is a small elasticity of both supply and demand (steep curves). Panel B shows a market where both supply and demand have large price-elasticities, but with demand more responsive than supply. As can be seen in Panel A, when the elasticities are equally responsive for supply and demand, the input support will generally be split equally between the producer and consumer, with the change in price of the product that results from the support being equal to half the per-unit support amount. In contrast, if the elasticities differ, the support will be spread unevenly between the producer and the consumer. In Panel B, where demand is more price-elastic than supply, less than half the support results in a price change to the consumer. In this case, more than half the support remains with the producer of the product. Depending on

◆ Figure 3.4. *The role of price elasticities of demand and supply in a closed economy on price, volume and leakage effects*



Key

S represents the supply curve before the support is applied, S' is the supply curve after the support, D is the demand curve, p is the initial price, p' is the price after support, U is the shift in the supply curve due to the initial value of the support, ΔP is the price change that will result after demand and supply have adjusted, and ΔQ is the quantity change.

Source: OECD.

whether the objective is to support the producer or the consumer, this may be seen as a high or a low transfer efficiency. Regardless of which objective the support is intended to fulfil, the relative elasticities of supply and demand will determine the transfer efficiency of the measure.

Panels A and B can also be compared to illustrate how the demand and supply elasticities will influence the volume effects of the support. The larger the elasticities of both supply and demand, the larger the increase in the quantity of the product produced will be as a result of the support. Assuming constant emissions per unit of product produced, these larger volumes will result in larger levels of emissions and waste.

The role of price elasticities of demand and supply

Table 3.1 below summarises the transfer efficiency and potential environmental effects of a support measure which reduces the cost of inputs, depending

Table 3.1. **Effects of price elasticities in the finished product market on transfer efficiency and environmental effects: support that is dependent on inputs**

Price elasticity of demand	Large	Large	Small	Small
Price elasticity of supply	Small	Large	Large	Small
Transfer of the support to the recipient sector	Effective	Moderately effective	Ineffective	Moderately effective
Potential environmental effects	Moderate to small	Large	Moderate to small	Small

Source: OECD.

on the supply and demand elasticities on the finished product. As discussed above, it is possible to examine only the output market for the finished product to arrive at the general conclusions drawn in Table 3.1, as the elasticities of supply and demand on the input market will be incorporated into the price elasticity of supply for the finished product. Likewise, it would have been possible to examine only the input market instead.

The previous analysis, on which Table 3.1 is based, has been carried out on the basis of a closed economy. In reality, however, many support measures are applied to products that are traded internationally. Once foreign buyers and suppliers come into play, price elasticities will generally become larger. The degree to which these elasticities will be larger, compared with the closed economy case, depends on the extent of foreign supply and demand (see Annex 3). According to the table, these larger elasticities will correspond to large potential effects on pollution, and – when the elasticities are of the same magnitude – more or less an equal split of the support between suppliers and customers. To determine whether the pollution effects will take place within the country or abroad, or whether it is the domestic or foreign producers and consumers that benefit from the support measures, will require a separate consideration of the nature of the support measure.

The previous paragraphs illustrated the role price elasticities of supply and demand play in determining the transfer efficiency and volume (environmental) effects of support measures, using an example of the effects of cost-reducing support to a producing sector. As stated earlier, support can be given for other reasons as well. What will be seen as transfer efficiency for any given support measure will depend on who (input producer, finished product producer/input consumer, or finished product consumer) is the intended recipient of the support. If, for example, the objective of the support is to bring down the selling prices of

the producing sector, thus supporting the consumers of the product by allowing more people to buy it (or to buy more of it), the transfer efficiency should be measured in terms of the *decrease* in price of the product. The role of the price elasticities of demand and supply then become reversed. For example, during the oil crisis of the 1970s, the Dutch Government offered a “consumer” subsidy for the purchase of thermopane windows (Wolfson, 1990). However, because this fell on an inelastic short run supply, it resulted in windfall profits for the thermopane window producers, rather than supporting the consumers and increasing the supply of the windows. Thus, if the objective is to support the consumer of a finished product through reducing the price of a purchased product to the production process, and if a product is sold on a market with a large price elasticity of demand and a small price elasticity of supply, then the transfer efficiency will be low and the potential environmental effects small.

The elasticities also conceal many important underlying factors which, in themselves, could serve equally well as criteria for prioritising support measures for removal or reform. Most of these characteristics can be understood only with more detailed information on the production processes of the sector itself. They include the composition of inputs, the prevailing taxation regime, relevant regulations, and the long run technical possibilities of the recipient sector to change its production process. In essence, the price elasticities are not constant over time. Nevertheless, an analysis of the demand and supply elasticities can serve as a first sift to prioritise support for reform or removal that is either not effective in generating more profits for the recipient sector, or has the potential to cause significant environmental damage, or both.

3.2.3. Support that is not conditional on production or input levels.

For example: direct income support, unconditional lump sum support to an industry

Of course, if there are no direct links between the support given and the production or input levels, the support will not *directly* encourage extra production. On the other hand, increased income levels in the recipient sector will stimulate consumption or production expenditures by the recipients. But it will not “lock-in” the use of particular production technologies or inputs, or the production of specific commodities, which otherwise would not be feasible. Because such support has no direct effect on the input or output markets, there will be fewer distortive upstream or downstream leakage effects, and a larger proportion of the support will accrue to the intended recipient sector than does for other support mechanisms. In sectors where income tends to correlate to employment levels (such as for agriculture), a positive effect on employment may be expected from such support.

3.2.4. Economy-wide effects and technological change

The total effects of a support measure on growth, employment, income and environmental degradation in the recipient sector will depend to a large extent on the mechanisms briefly sketched above. The support, however, must be paid for from some other sector(s) in the economy as a whole, reducing the economic opportunities in those sector(s). Moreover, support which is conditional on a particular product will tend to lock-in the technological trajectories of the supported product. Thus, if producers are guaranteed a minimum price and quantity sold for a given product, they will be less likely to consider new, un-supported products or processes that might, without the benefit of the support, prove more cost-effective and less environmentally-damaging. In the long run, this may be detrimental to the overall competitiveness of the economy.

The economy-wide costs of funding support measures are often more difficult to identify or calculate than the benefits the supported industry may receive from the support. This is generally because a larger, more diffuse, base of different sectors and groups in society will fund the support (for instance, all agricultural consumers when agricultural minimum price support measures are in place, or all income earners in society when support is funded through increased income taxation), compared with the more cohesive and smaller sector or group that will benefit from the support. Because there will usually be a larger number who pay for the subsidy than those who gain from it, each beneficiary will generally receive more than each loser pays out, even when the transfer efficiency is low such that the intended recipients receive only a small share of the allocated support. This provides a greater incentive for the beneficiaries of the support to lobby to keep the support in place than for the losers to try to ensure it is removed. In addition to this direct monetary incentive, the beneficiaries will often also be better equipped to form an influential lobby group because they will come from a more distinct and cohesive group in society. Finally, while the costs of support removal (to the recipients) will often be immediate, many of the environmental benefits will only be realised later, and over a longer period of time. Both because of this uneven lobbying pressure and because the economy-wide costs of the support are so much more difficult to identify than the sectoral benefits, it is often the case that support measures are maintained which represent a net drain on the economy.

The economy-wide, and the sector-wide, effects of support removal will also be strongly determined by the openness of the economy (Verbruggen and Oosterhuis, 1998 forthcoming). In addition, even in the most homogenous industries there are niche markets and other characteristics which will make it difficult to predict beforehand how the removal of a support will affect the international competitiveness of the industry.

The dependence of environmental performance on technical change

Support that is tied to the production of a particular product, or the use of a particular process or input will tend to lock-in the technological trajectories associated with these. But most environmental policy achievements have been dependent in the past, and will likely be in the future, on the development of new technologies. Those environmentally-beneficial technology changes that have occurred have generally resulted in strategies that can be categorised as either end-of-pipe solutions or approaches that increase resource productivity (dematerialisation, materials substitution, recycling and reuse, and waste minimising).¹⁷ The box below indicates the main strategies available within these two categories. Resource productivity approaches are generally more effective than end-of-pipe technologies in reducing emissions and waste, and are often more cost-effective as well. Reducing support to production and consumption may render even more of these strategies cost-effective under the prevailing market conditions. The common characteristic of resource productivity approaches is that they lead to the need for less materials and energy to produce the same goods and services, or the substitution of less environmentally-harmful inputs in place of the more harmful ones. However, a word of caution is in order: increased resource productivity may also lead to increased levels of production and consumption, partly or wholly offsetting the environmental gains from reduced pollution and waste per unit of product. Moreover, increased resource productivity may also lead to other side effects, like the increased use of materials that are more difficult to handle in the waste stream. Rather than continuing support regimes that encourage production processes with low resource productivity rates, an optimal solution would be to reduce the support levels and use appropriate environmental policies to address any environmental problems.

Support that locks-in the use of certain resources

Support measures can be linked to substance flows in various ways. The most direct link is when the support measure is obtained only if a quantity of a specified material or energy source is purchased or when a quantity of product is sold (i.e., support dependent on input or output levels). An example of support dependent on output levels is when special low rates of sales taxes are applied to the supported commodity. In such a case, the consumer of the commodity will benefit from the support only through purchasing the product. The least direct link will be when a sector obtains support that is linked neither to its levels of input or its production. But the more direct the link, the greater the potential environmental damage the support may result in. Of course, particularly strong effects can be expected from support schemes that combine two direct linkages,

A typology of the main technological strategies of environmental policy

Category	Main strategies of environmental policy	Examples
End-of-Pipe Treatment (Pollution Control)	1. Reducing the toxicity of pollution and waste Transforming pollution and waste into emissions and waste streams that are less hazardous, or managing them in a more environmentally-benign manner	Waste water treatment, flue-gas desulphurisation, remediation activities, sequestration and disposal of waste in "safe" disposal sites
Increasing Resource Productivity (Pollution Prevention)	1. Dematerialisation More efficient use of a given material for a given function 2. Materials Substitution Substitution of a given material by another, less hazardous (including less energy-intensive) one 3. Recycling Repair, re-use, remanufacturing and recycling of products 4. Waste Mining Recovery of materials from production waste	Energy saving measures, less fertiliser and/or pesticide use per unit of agricultural output, increased vehicle fuel efficiency (including reductions in vehicle weight), micro-miniaturisation in the electronics industry Substitution of glass or aluminium fibre for copper wire, replacement of CFCs by other materials, use of less malign pesticides, use of aluminium or other light weight materials in vehicle construction Recovery of metals from discarded products, recycling of paper and glass, energy recovery by incineration of discarded products Recovery of elemental sulphur from flue-gas desulphurisation, recovery of limestone from scrubber waste, recovery of fertiliser by applying closed production systems in agriculture

Source: Adapted from Ayres and Ayres (1996).

All of the strategies delineated in the table above have strong and weak points. Which strategy will be the best solution in any given situation will depend largely on the particular circumstances of the environmental problem it is required to address. Sometimes the choice of available strategies will be limited. Nevertheless, increasing resource productivity is generally considered to be more cost-effective than end-of-pipe technologies – preventing pollution and waste from being generated is often cheaper than trying to reduce their toxicity and dispose of them after their generation. Where there is dissipative use of materials, pollution prevention may even be the only option to reduce pollution levels.

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(continued)

Resource productivity strategies are not only often preferable from the polluters viewpoint, but also from the wider perspective of reducing the costs of environmental policy in general. If the pollution is not generated in the first place, it will also not be necessary to design environmental policies to address its environmental effects. Another compelling reason for concentrating on resource productivity strategies is the growing share of difficult to control emissions from non-point sources (such as from agricultural run-off, transport emissions, and the dissipative use of materials). Strategies for addressing pollution from non-point sources necessarily rely heavily on measures to reduce or substitute the inputs that give rise to the emissions, as it is more difficult (and sometimes impossible) to apply end-of-pipe treatments in these situations.

for example if low rates of fuel taxation are applied to producing sectors that also receive support in the form of tax exemptions for the use of other inputs or processes.

Support that favours the use of particular resources over others will bear strongly on marginal costs and revenues, and therefore will have a strong effect on the composition of output. This type of support will also impede development towards greater resource efficiency, on which future environmental improvements are increasingly dependent. This is especially the case when addressing pollution from non-point sources, like agriculture and transport, but also in further reducing the emissions from stationary sources and in managing waste streams. Attempts to increase resource efficiency may be severely discouraged if support continues to favour present day resource use. It is difficult to overestimate the potential effects of resource efficiency strategies. It has been estimated that achieving agreed CO₂ objectives in the Netherlands by the year 2040 without material substitution would cost roughly twice as much as a policy which encourages substitution by less energy intensive materials (Okken and Gielen, 1994).

3.2.5. Environmental effects of support are not linked to its effectiveness in reaching the intended recipient sector

Because of low rates of transfer efficiency, the effectiveness of market price support measures and support linked to input use in maintaining income and employment levels in the intended recipient sector is significantly reduced. At the same time, if the support is conditional on the levels of input use or production, it may still have large effects on the amount of resources used and the waste generated. After all, in order to receive the support (even if it is small in net terms

because of leakage effects) the recipient will still have to undertake the conditions on which the support is based, and it is these transactions that will result in the environmental damage. For example, because the input intensity in agriculture is high, much of the market price support to agriculture is likely to be dissipated to upstream input producers. But the potential environmental effects are related to the total input and production levels, which will still increase, not to the effect on farmers' incomes. This asymmetry may be larger in the case of support to input use. Support to inputs will lead to higher levels of input use, and much of the support may leak away to the input supplier rather than accruing to the intended recipient.

A quick scan for prioritising support measures to be eliminated or reformed

The crucial role price elasticities of supply and demand play in determining both leakage and volume effects makes it possible that support measures can be scanned using these characteristics to determine those support measures that are unlikely to reach the intended recipient sector effectively, but are likely to have strong adverse effects on the environment. Using this quick scan, as developed in the previous analysis, an evaluation of support measures with a view to removing or reforming those that are economically inefficient and environmentally-damaging, should concentrate on those measures that are aimed at recipient sectors which

- *operate on markets for their finished products that are characterised by either*
 - *a relatively small price elasticity of demand and a relatively large price elasticity of supply, since these support measures tend to be ineffective in transferring income to the intended sector; or*
 - *a relatively large price elasticity for both demand and supply, since these support measures are only moderately effective in transferring income to the intended recipient sector, while at the same time will have potentially large adverse effects on the environment.*
- *are relatively material- or energy-intensive.*

A quick scan should, however, incorporate several other elements as well, particularly an examination of how the support would be distributed across the intended recipients. Support conditional on output and input levels tends to accrue primarily to the relatively large, and often more wealthy, producers and users. Thus, these support measures tend to favour those who need the support the least. A quick scan, of course, will not automatically identify all support measures that should be removed or reformed. Nor can it be the only method for prioritising support for removal. First, this is because there are other policy decisions involved, notably whether governments prefer to bear the associated higher costs of environmental policy implementation, rather than reducing or

removing support measures that encourage the environmental damage. Second, because the actual market responses to price changes – especially in the long run – are very hard to predict (see Chapter 4). Quantitative information can underpin decisions about support removal to a certain extent, but the final political judgement must take into account the wider implications of market distortions as well, including its long-term effects on economic efficiency, competitiveness, incomes, employment and equity. Such market distortions are associated with support measures that are conditional on materials, energy use and particular technologies which tend to have a stifling effect on technological change and future competitiveness. Thus, the use of such quantitative information in the quick scan described above may enable a rough indication of support measures whose reform or removal might result in “win-win” situations for both the economy and the environment.

4. EMPIRICAL EVIDENCE

4.1. AGRICULTURE

4.1.1. The environmental impacts of agricultural reform

Policy reform

There is broad agreement among OECD Member countries that policy reform should strive to improve the compatibility of agricultural activities with the environment, while allowing for a greater influence of markets in guiding production and consumption decisions. Accordingly, many countries have engaged in substantial agricultural policy reforms in recent years. These policies have taken many forms, including changes in support schemes, structural policies and accompanying measures.

Several studies have examined the environmental effects of these policy changes. The following discussion is based mainly on *The Environmental Effects of Reforming Agricultural Policies: A Preliminary Report* (OECD, 1998). It assembled a substantial amount of evidence on the environmental effects of agricultural activities and policies, covering a wide range of policy, economic and environmental situations. The results are preliminary, reflecting the diversity of the material and data available and the *ad hoc* nature of their interpretation.

Policy reform is not only concerned with reducing direct support, but also entails reforms of a variety of other policy measures. As discussed in Section 2.2, market price support and input subsidies have been reduced in many countries, together with an increase in direct income payments and the general services provided to agriculture. The overall effect has been a decline in the total level of support. The shift in the composition of support was reinforced in 1996 by a further reduction in market price support due primarily to high world prices and, to a lesser extent, by continuing policy shifts away from price support and toward payments based on area or headage. Direct income payments have mainly been used to compensate reductions in market price support and to facilitate adjustment to a more market-oriented environment, but there has also been a move to decouple payments from specific commodities. Many countries have continued their use of quantitative restrictions on outputs and inputs to limit excess sup-

plies, although some of these restrictions have recently been reduced or eliminated.

Environmental linkages

The sequence of causality linking agricultural policies to the environment flows from the impact of changes in policy measures on farming practices and activities, which then in turn impact on the pressure placed on the environment. Agricultural policies influence farming activities through changing (relative) output and input prices, direct and indirect restrictions on output and input use (quality requirements, quotas), (dis)incentives for the development and adoption of new technologies and practices, measures distorting resource use decisions, and measures that alter the agricultural and rural infrastructure. These policy measures are often applied in combination. But agricultural practices are also determined by other factors, including farmer awareness, pressure group activity, technological change, market developments, natural events and environmental changes. These factors are autonomous from the support itself to a certain degree, but may in turn be influenced by agricultural and environmental policies and regulations as well.

Agricultural activities influence the environment by impacting on: *soil quality*, including soil texture, erodibility, nutrient supply, moisture balance, salinity, and soil conserving functions including flood prevention and landscape protection; *water systems and water use*, especially through surface and groundwater pollution, and irrigation; *air quality*, including substantial emissions of greenhouse gases (notably CH₄ and NO₂); *biodiversity, wildlife habitat and ecosystems*; and *landscape*.

The degree to which agricultural activities affect the environment depends not only on the quantities of agricultural goods produced and the amounts of inputs used, but also on “good housekeeping” practices, such as applying the right doses at the right time. These practices, in turn, are influenced by a variety of regulations and policy incentives. The effects the farming practices will have on the environment will also be dependent on site-specific agri-environmental conditions.

Estimating the environmental effects that result from changes in support measures therefore faces four analytical problems: disentangling these effects from the effects of other policy changes, disentangling them from other autonomous developments, weighing up the often contradictory trends in the environmental effects, and deriving general systematic conclusions about the effects of support measures from observed developments that are often site specific. Moreover, the main changes in support measures and the introduction of agri-environmental measures (which encourage land owners to undertake practices with desired environmental results) have occurred primarily in recent years.

Therefore, it is too early to determine what their long-term impacts on the environment will be. While there has been some progress in developing agri-environmental indicators, there is still a lack of qualitative and quantitative data for environmental performance assessment. In spite of these analytical difficulties, some general conclusions on the environmental impacts of support reform can be drawn.

Overall effects of changes in support measures

By lowering price support and input subsidies and shifting to direct payments and other less economically distorting ways of providing support, policy reforms have in many cases generated a double benefit. They have resulted in a more efficient allocation of resources and have often reduced the negative and enhanced the positive environmental effects of agriculture. They have also increased the transparency of the support mechanisms and highlighted the need for environmental measures targeted to specific externalities. The economic gains that would result from a better resource allocation could justify the use of such targeted measures.

Reductions in price support have lowered the demand for chemical, mechanical and irrigation water inputs to supported agricultural production. They are likely to have led to less intensive crop production as well as a shift away from production on marginal lands. However, some land may have been shifted into other chemically-intensive production as a result, such as to fruit and vegetables. In some cases, the use of farm chemicals may have increased after an initial decline, mainly due to developments in world commodity prices. Reforms in the livestock sector have resulted in smaller animal herds and lower livestock densities, thereby reducing grazing pressure and manure surpluses and, as a consequence, soil erosion and nutrient leaching. However, where direct payments per head of animal have been provided, in conjunction with government-determined stocking density limits that exceed those prevailing in the area, animal densities may have increased.

Policy reforms can also reduce the positive environmental externalities associated with agriculture. In certain countries, agri-environmental support has allowed farmers to maintain farming practices that support a rich variety of flora and fauna and to create scenic landscapes that are valued by the population. Such production practices, which might be unprofitable without the support, are often located on economically marginal but ecologically valuable land. They can cover relatively small areas, but can also extend over large areas of semi-natural land. In other cases, agricultural activity has been associated with land conservation, including landslide and flood prevention. There have been concerns in some countries that these positive environmental externalities associated with agricul-

ture might be reduced if reform causes agricultural activity to shrink. However, such concerns will be better addressed directly through targeted environmental measures, rather than by slowing down agricultural policy reform. The consequences (positive or negative) of policy reform and trade liberalisation for the environment will thus depend crucially on whether the external environmental costs and benefits of agricultural activity are included in farmers' costs and revenues. Where such costs and benefits are internalised, the changes in production and farming practices that will result from support reductions will contribute to ensuring sustainable resource use.

The multilateral trading rules established by the 1994 Uruguay Round of the General Agreement on Tariffs and Trade and the numerous regional and bilateral trade agreements concluded in recent years are likely to increase the volume of international agricultural commerce, create new trade flows and pathways, and shift regional production patterns. As a result, some countries will produce less while others, especially countries able to expand production under lower levels of support, will take advantage of the new trading opportunities and increase production and exports. Regions with shrinking agricultural production may experience some environmental improvements, in particular where harmful environmental impacts caused by the use of pesticides, fertilisers, irrigation water and high livestock densities are alleviated. However, regions with expanding production may encounter extra pressure on the environment.

While it is clear that trade liberalisation affects production patterns and trade flows, the size of the impact is uncertain. Preliminary analyses suggest that the production shifts may not be very large and that the adjustments will take place gradually. In general, no substantial environmental benefits or damage are expected, but in specific areas the environmental impacts could nevertheless be significant. Where negative environmental externalities arise from output expansions or contractions, appropriate measures would have to be taken to ensure they are adequately reflected in the markets. In other words, the environmental and agricultural impacts of trade liberalisation and support removal will depend on the degree to which environmental effects are incorporated into farmers' decision making.

The expansion in the volume of trade will require more international freight traffic, although there is some indication that the extra traffic generated may be relatively small. Pollution from freight traffic depends to a large extent on the mode of transportation used. By pursuing an appropriate transport policy, countries could encourage any increased traffic to make use of the less environmentally-harmful transport modes, particularly rail and shipping, thus limiting the increase in (and potentially even reducing) traffic pollution. Similarly, increases in the risk that plant or animal pests and diseases enter a country through trade when borders become more open should be addressed through appropriate

sanitary and phytosanitary measures, rather than by slowing down the process of trade liberalisation.

4.1.2. Analysing the effects of support measures in more detail

To increase understanding of the environmental effects of reducing support to agriculture, it is necessary to first isolate the effects of the support on farm practices, as it is the change in farm practices that will determine how the environment is affected. In order to gain such an understanding, an economic incidence analysis must be undertaken. Inevitably, not all of the support that is directed towards a particular sector will actually reach it. Instead, some will leak away either to upstream input producers or downstream consumers. OECD research into the transfer efficiency of agricultural support has found that as little as one-quarter of what consumers and taxpayers pay to agricultural producers through price support may actually translate into additional net farm income (OECD, 1995). The other three-quarters leaks away primarily to extra expenditures on purchased inputs and foregone earnings on diverted farm resources. As a result, OECD consumers and taxpayers could gain more from the elimination of farm price supports than the farmers would be likely to lose.

Of course, a range of measures are used to support agricultural production in OECD Member countries, each of which will have different levels of economic costs, distributive leakages and environmental effects associated with it. One study (OECD, 1995) has ranked three different agricultural support instruments according to their transfer efficiency rates. The results can be seen in Table 4.1 below. For each distributive characteristic, the policy instrument with the *highest* transfer efficiency (lowest leakage rate) is ranked with ***, and the one with the *lowest* transfer efficiency is marked with a single *. A question mark indicates uncertainty in the rankings.

Distributive leakages represent that portion of the benefits of agricultural support that might be captured by industries that supply inputs to farmers and those that transform the raw farm products into intermediate or final goods, rather than accruing to the farm income. These do not constitute net income losses to the economy, but represent income flows to non-target groups. Market price support policies and deficiency payments are equally output increasing and potentially favour capital inputs and intensification. Thus, unlike direct income support (which is not linked to production) they may result in the leakage of support income to upstream industries. Both the market price supports and deficiency payments also increase the quantity of the raw farm product available to the downstream industries, but only the deficiency payment potentially lowers its price. Whether support is actually leaked to the downstream industries from these policies will depend on a range of conditions governing the trade of the

Table 4.1. **Transfer efficiency rankings^a of agricultural support policies**

Distributive leakages to non-target groups	Policy instrument		
	Market price support	Deficiency payment	Direct income support
Administrative costs	***	*?	**?
Leakages to upstream industries	*	*	***
Leakages to downstream industries	?	?	***
Leakages to non-target farmers	*	**	***
Income transfers to or from foreign countries	*	**	***

a) Because the policies are ranked relative to each other only, it is not possible to merely "add" the results for each evaluation criterion and determine an aggregate ranking for each instrument.

Source: OECD (1995).

good in the local market, particularly the supply and demand elasticities on the output market. Thus, support to agriculture in the form of guaranteed high market prices and deficiency payments will generally result in larger leakages of the support to non-target upstream and downstream industries, as well as greater distortions in producer and consumer choices (*i.e.*, deadweight losses to the economy), than direct income payments. In addition, because the first two measures encourage increased production and input usage, they will often also lead to increases in the land degradation and pollution levels associated with production.

These results strongly suggest that direct income payments, which are not linked to production, may be a considerably more effective means of providing support to farmers, although even with these measures some of the support will be leaked away from the target recipient through administrative and taxation costs. In contrast, with deficiency payments and market price support policies there are generally both significant deadweight losses and a lower transfer efficiency of the support to farm incomes. As a result, the amount of direct income payment that would be required to compensate for the loss of net farm income from the removal of a price support will be substantially below the total transfer amount of the original support. Because it does not stimulate additional production or intensification of agricultural practices, direct income support will also result in less damage to the environment.

4.1.3. Lessons from case studies on the environmental impacts of support to agriculture

Rainelli and Vermersch (1998 forthcoming) analysed how 1992 changes in European Union support policies affected irrigation practices in France. The rele-

vant policy changes that took place in France included a reduction in the intervention price of cereals (the market price support) and an associated compensation to farmers of direct area payments.¹⁸ The compensation payments were based on farm size and regional yields, and were subject to set-aside conditions. As a result, this scheme made the direct income payments dependent on the past relative prices and agricultural practices used by each farm. Thus, the payments captured the value of any intensive farming practices used (particularly irrigation) in the value of the compensation paid to the farm, and therefore in the value of the farmland.¹⁹ This led to an incentive to maintain high marginal productivity levels on these lands, locking-in the use of irrigation water on those farms where previous use had led to high yields, which are now reflected in the compensation payments. Thus, one of the outcomes of the support scheme was to induce further irrigation and complementary fertiliser use. Instead of leading to extensification, this compensatory measure resulted in an increase in the environmentally-damaging farm practices. Although the policies represent a move towards direct income payments, by linking them to past levels of production and profit they provide no incentive to reduce the environmentally-damaging practices that were taking place under the previous market price support scheme. While in general a switch from market price support to direct income payments will both benefit the environment and lead to a higher transfer efficiency of the support itself, such measures need to be carefully formulated so that any potential environmental benefits are realised.

A second case study (Helming and Brouwer, 1998 forthcoming) illustrates several important points. This study used a regionalised, comparative static partial equilibrium model, under the assumption of infinite price elasticities of agricultural outputs and purchased inputs, to analyse the effects of changes in the relative prices of nitrogen inputs in agriculture to the use of the inputs and nitrogen emission levels in the Netherlands. The analysis found striking differences between the different nitrogen taxation scenarios analysed with respect to their estimated effects on both the resulting nitrogen levels and gross profit margins for the various livestock and crop sectors examined. As economic theory would suggest, it was found that a tax on nitrogen surpluses (*i.e.*, an emissions tax) is a more efficient policy tool for reducing nitrogen usage in agriculture than the taxation of nitrogen-rich fertiliser or food concentrate inputs, or both. Thus, for a given level of reduction in the margin between revenues and marginal costs experienced by the sector as a result of the taxes, the tax on nitrogen surpluses was found to lead to a larger reduction in nitrogen emissions than the tax on nitrogen inputs. The study highlights the importance of the various intermediate deliveries of manure and fodder between livestock crop production and agribusiness activities, resulting in strong interdependencies between these sectors within agriculture. Implicitly, the spatial dimension, both

in terms of the distances between the activities and the differences in the assimilative capacity of the local environment, plays an important role.

This study can be seen as complementary to the aforementioned study by Rainelli and Vermersch. While the Rainelli and Vermersch study examined how changes in agricultural support policies affected the use of irrigation water and intensive farming techniques (the production function) at the farm level, Helming and Brouwer concentrated on the links between various subsectors of the agricultural production system through an examination of how the intermediate deliveries between them are affected by changes in the relative prices of nitrogen-based inputs.

4.1.4. Decisive factors

Factors that determine the economic effects of support

According to the previous section, the characteristics that determine the economic effects of an agricultural support measure, in terms of the efficiency of the support in increasing the incomes of the intended recipients (farmers), are:

- *the characteristics of the support – in particular the nature of the support (market price support, support to inputs or direct payments), the points of impact/conditionality of the support on the levels of input and output, and its significance in the farm cost structure; and*
- *the characteristics of the input and output markets of the recipient sector – in particular, the price elasticities of demand and supply generally determine the proportion of the support that leaks to non-target recipients, such as agricultural input suppliers and consumers of the agricultural produce.*

Because the agricultural sector is so heterogeneous – with considerable variations in the production techniques used, the size of the farms, etc. – and because of the prevalence of intermediary deliveries between subsectors of agriculture, it is difficult to draw general conclusions about the precise economic effects of support removal. Nevertheless, support measures that are conditional on output levels or the use of particular inputs are more likely to result in large proportions of the support accruing to non-target consumers of agricultural produce or input suppliers than support measures that are decoupled from production.

Factors that determine the environmental impacts of policy reform

Removing support that is conditional on levels of output or input is widely seen as an important step towards steering farm management decisions away from overuse of inputs and overproduction. As such, replacing support measures conditional on levels of input or output by forms of direct income support, as is

taking place in many OECD Member countries, will generally lead to environmental benefits. However, if the direct income support is not fully severed from past or present input or production levels, the potential environmental benefits of the change in the composition of the support will be reduced. Direct payments that are linked to previous levels of production or input use may significantly lock-in the previously used practices, thus diminishing the potential for these measures to encourage the recipients to reduce input intensity (as was seen in the Rainelli and Vermersch study cited above). Another common trend is the coupling of support measures to the undertaking of particular environmentally-beneficial farming practices. This is seen as a form of payment to the farmer for the positive externalities farming practices generate. These types of support measures are not analysed in the present report.

The long-term environmental benefits of removing agricultural support are likely to exceed the short-term benefits. In particular, where support is decoupled from environmentally-harmful inputs or production processes, the farm practices may adjust to reduce the use of the no-longer supported input. While some changes can take place immediately, others will require longer term commitment and investments.

Environmental factors

Many of the adverse effects of agriculture on the environment are influenced by environmental conditions at the point of reception of the emissions. Thus, for example, an application of nitrogen that gets fully absorbed by the crops may have no negative effects on the environment, while the same application in another environment can lead to significant damage when applied under situations where the nitrogen can leach out of the soil instead. As a result, the full environmental effects of support reform or removal often depend critically on the prevailing local environmental conditions.

4.2. ENERGY

4.2.1. Lessons from case studies on the environmental impacts of removing support to energy

In 1992, the World Bank's yearbook, the *World Development Report*, drew attention to an issue that had so far received little attention: the contribution of energy subsidies to environmental damage. Since then, various studies have shown that removing energy subsidies could make a substantial contribution to the aim of reducing OECD Member countries' CO₂ emissions. It seems to make eminent sense that, before examining carbon taxes and other measures to control pollution from coal use, subsidies for coal production should be removed. The OECD's

Group on Energy and the Environment decided in late 1992 to look into this issue in more depth, and set up an Expert Steering Group to carry out a series of country case studies evaluating the environmental and economic effects of removing energy subsidies. This section gives a brief summary of the findings of those studies.

Environmental linkages

There are considerable variations in the case study findings, and even between studies of the same policies within any one country.²⁰ This is largely due to differences in the scope of analysis, definitions of support and the models used. The estimated behavioural responses of energy producers and consumers to support removal depends very much on the magnitude and form the support takes, the elasticities of supply and demand for energy, the alternative energy sources and technologies available, and the assumptions made regarding autonomous developments. Together, these factors will determine the magnitude and composition of energy output. The environmental effects of the support measure will be determined by the energy output in combination with the environmental regulations in place and envisaged, and the assimilative capacity of the environment.

The case studies under review²¹ focus primarily on the effect of support removal on greenhouse gas and other air pollution emissions. However, energy production and usage affect the environment in a range of different ways, primarily through the emission of a range of pollutants and the use of non-renewable resources. Thus, energy activities impact on the environment through: *air quality*, including the release of pollutants that lower local ambient air quality and the emission of greenhouse gases which contribute to global climate change; *water systems*, including through the deposition of acid rain and hazardous air pollutants, accidental oil spills, potential nuclear waste leakages, the development of dams for hydro-electric power generation, and the pollution of water used in the processes of energy production and refining; and *land use and soil pollution*, including through the siting of mines and energy-related facilities, the deposition of acid rain and hazardous air pollutants, the disposal of large amounts of solid waste from some of the production processes, and potential nuclear waste leakages. In addition, the support of energy production and consumption can have significant downstream effects on the structure of consuming industries. Governments can and do attract energy-intensive industries through the supply of subsidised energy. For example, primary aluminium manufacturers, for whom electricity represents almost one-third of total production costs, have been found to cluster around government supported energy sources (Koplow, 1996). This support has a positive effect on the viability of primary aluminium relative to secondary aluminium, the production of which requires 95 per cent less energy. Thus, support to

energy generation can also have large environmental impacts through its influence on downstream industries.

Most of the OECD case studies evaluate the effects of policy reform on energy demand, fuel and technology choices. Based on this information, reductions in CO₂ emissions can be relatively easily calculated, but other emissions depend more heavily on the technologies used for power generation and the existing environmental policies. Thus, the case studies found that removing support to energy production and consumption could reduce CO₂ emissions by tens of millions of tonnes in the main coal-using countries, while also reducing the cost of electricity production. Reductions in other greenhouse gases, such as methane, are also likely and may well be larger in percentage terms than those for CO₂ (Steenblik and Coroyannakis, 1995). Because the case studies differ in the models, assumptions and data they use, their estimates are not directly comparable. Instead, they give an indication of the range of findings available from different studies of support removal in different countries, under different assumed circumstances and over different time scales. In spite of the variations in results, all of the case studies show that removing support to energy will have a positive effect on reducing emissions of carbon dioxide and other environmentally-damaging pollutants, as can be seen in Table 4.2 below.

All the studies estimated environmental effects of removing support to energy that were positive, though generally small with the exception of Russia, where substantial reductions in CO₂ emissions were predicted. However, all such analyses are subject to the constraints of the models and assumptions used. As a result, estimates can vary significantly – as can be seen in the box below where a comparison is made between two analyses of the removal of coal producer subsidies in Western Europe and Japan. A number of modelling constraints were involved in these case studies, some of which are likely to have resulted in underestimates of the potential environmental benefits of energy support removal. For example, the time frame of analysis used in most of the case studies spanned only fifteen to twenty years, a period that is likely to be too short to include the more significant long-term effects of support removal. Often the electricity supply industry has long-term commitments to particular fuel sources as a result of purchase agreements and the large sunk investments in plant infrastructure. As a result, the long run responses to support removal are likely to prove more elastic and have larger environmental benefits than the short- and medium-run responses. It is only as existing plants reach obsolescence and new investment is required that the full potential reductions in emissions will occur. Thus, in the DRI study, the reductions in support payments tail off at 2010 but the emissions, as compared with the base case, are still continuing to decrease at that time.

Table 4.2. Summary of results from OECD studies on energy support removal

Study	Subsidy or group of subsidies to be removed	Monetary equivalent of distortion (US\$ million per annum, various years 1988-95)	Decrease in annual CO ₂ emissions by 2010 from reforms relative to reference scenarios	
			Million tonnes CO ₂	% in sector concerned
6 OECD countries DRI (1997)	• Coal PSEs in Europe and Japan	5 800	10 (DRI est.) >50 (OECD estimate)	1
Australia (Naughten <i>et al.</i> , 1997)	• State procurement/planning	133	0.3	
	• Barriers to gas and electricity trade	1 400	0.8	NQ
	• Below-market cost financing	NQ	NQ	NQ
Italy (Tosato, 1997)	• Net budgetary subsidies to the electricity supply industry (ESI)	4 000	12.5	
	– VAT below market rate	300	0.6	
	– Subsidies to capital	1 500	3.3	
	– Excise tax exemption for fossil fuels use by ESI	700	5.9	
	• Total net and cross-subsidies	10 000	19.2	5
Norway (Vetlesen and Jensen, 1997)	• Barriers to trade	NQ	8 (for Nordic region)	
Russia (Gurvich <i>et al.</i> , 1997)	• Direct subsidies and price controls for fossil fuels	52 000 ^a	336 ^b	16
	• Price control/debt forgiveness for electricity consumers			
UK (Michaelis, 1997)	• Grants and price supports for coal and nuclear producers	2 500	0 to 40	0-8
	• Below-market required rate of return for the ESI			
	• VAT on electricity below general rate	1 200	0.2	
USA (Shelby <i>et al.</i> , 1997)	• DFI (1993) analysis ^c	8 500	40	0.7
	• DJA (1994) analysis ^c	15 400	235	4

Note: Subsidies are defined in various non-comparable ways. All estimates in the table are open to wide margins of error.

NQ: not quantified.

a) Of which US\$42 000 million was for heat and power.

b) About half of the reductions were due to a shift from coal to other fuels, and half due to reduced final energy demand.

c) The DFI and DJA studies analyse different sets of energy supports and use slightly different estimates for some of them.

Source: OECD (1997a).

The effects on CO₂ emissions of removing coal production subsidies in Western Europe and Japan – a comparison of two studies

Two recent studies (DRI, 1997 and Anderson and McKibbin, 1997) modelled the effects of removing support to coal production in OECD Member countries. Both studies examined total support removal to coal production over the period 1990 to 2005 (2010 for the DRI) and over a similar range of countries, but using different modelling techniques and assumptions about the base case scenario (see summary Table below). Anderson and McKibbin examined the results of removing coal subsidies and import restrictions in western Europe and Japan using a multi-country dynamic general equilibrium model of the world economy, and compared these results with a base-case scenario of maintaining the full 1990 support levels over the study period. The DRI study examined the impact of removing coal subsidies on world coal market prices, demand and substitution against a base-case scenario which assumed the implementation of those support reductions already agreed to by these countries over the study period. The base case scenario in the DRI study therefore assumed a reduction in total subsidies of just over half from approximately US\$13 000 million to US\$6 000 million by 2010, and compared this with the full subsidy removal scenario.

The Anderson and McKibbin study found that support removal would lead to reductions in coal production in the countries studied and an increase in coal imports. The increase in demand for imports would then force world coal market prices up, thereby encouraging reductions in coal usage and a substitution towards other fuels. The reductions in total coal usage would lead to significant reductions in CO₂ emissions world-wide. In the DRI study, it was estimated that reductions in coal production in the study countries would result almost entirely in a one-for-one replacement by imported coal, with only a small shift towards natural gas usage. Although an estimated increase in world coal trade of 15% was predicted, it was found that this would not significantly affect world prices because of the existence of ample spare production capacity. To a large extent, the differences in the estimated effects on world coal prices in the two studies results from the assumption in the DRI study of a flat global supply curve for coal and a rising one in the Anderson and McKibbin paper. The determination of the fuel mix in such predictions relies on the current substitution elasticities between different fuel types. However, these are dependent on the regulatory framework within which the policies take place, including the level of liberalisation that exists in complementary sectors such as electricity generation and supply.

As a result of these differences, the estimates of CO₂ emission reductions that would result from removing coal support differs significantly between the two studies. Under the DRI model it was calculated that full subsidy removal would result in a reduction in CO₂ emissions of just under one-third of one per cent per annum by 2010, compared with the base case scenario of partial support removal. In comparison, the model used by Anderson and McKibbin found that full

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removal of subsidies resulted in a reduction in CO₂ emissions of 13 per cent per annum by 2010 compared with the base-case scenario of no support removal.

These results highlight a number of important points. First, it is clear that reducing support to coal producers is likely to result in environmental benefits through reduced greenhouse gas emissions. In addition, the DRI study in particular emphasised that there would also be significant reductions in other emissions, such as the acid-rain forming sulphur dioxide. Second, it is clear that both the model that is used to estimate the economic and environmental effects of support removal and the assumptions embedded in the model, including the base case scenario against which support removal is compared, can significantly affect the results obtained.

	Anderson and McKibbin	DRI
Time period covered	1990-2005	1990-2010
Countries examined	Belgium, France, West Germany, Spain, UK, Japan	France, Germany, Spain, UK, Japan, Turkey
Support removed	All support removed compared with 1990	All support removed in excess of already agreed upon removals for period
Model used	Multi-country dynamic general equilibrium model	World coal trade model
Relevant mechanisms	Price and volume adjustments to coal production and consumption	Very small price effects, primarily substitution of domestic coal by imported coal
Annual CO ₂ emission reductions in final year	-13%	-0.30%

Source: Anderson and McKibbin (1997) and DRI (1997).

The DRI study also examined the employment effects of removing coal subsidies. It was found that, because of the low price and demand impact on the energy sector of removing coal subsidies, and the small contribution made by this sector to overall economic output, the macro-economic impact of removing the subsidies would be very limited. It was estimated that there would be a total loss of 174 000 mining jobs in the subsidy removal scenario, compared with the 1992 level of coal mining employment. This compares with an already expected loss of 70 000 jobs in the base case scenario, resulting from the already incorporated

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support reductions, natural wastage and resource exhaustion. Because of the geographical siting of mining operations, the effects of the employment losses would be expected to be strongly regional. Balanced against this, the support per coal worker in many countries is as much as twice their salaries, indicating a rather low transfer efficiency of this type of support if employment is the primary objective.

The environmental benefits that might result from any decrease in the demand for energy that results from support removal will also generally be larger than the average impacts per unit of energy would indicate. This is because marginal electricity demand is usually met by fossil fuel powered plants with low or moderate efficiency and with higher emission factors than baseload plants. As a result, decreases in electricity demand at the margin will have more environmental benefits than average decreases.

In addition, some of the case studies – including the DRI (1997) study – do not examine the effect of the ensuing increase in world coal prices on coal demand outside of the countries studied. A rough estimate of the effect on coal demand in North America of removing subsidies to coal producers in Western Europe and Japan found a further reduction in CO₂ emissions there of 36-39 million tonnes (OECD, 1997a). Thus, the impact of support removal on world CO₂ emissions through world market price increases could be more significant than through the internal domestic responses to support removal.

Effects of changes in support to energy

As was discussed in Section 2, support to coal producers remains substantial in several OECD Member countries. Table 4.3 below shows a summary of producer subsidy equivalents to coal.

The type of support measure in use will greatly influence the effects of support removal on the environment and the economy. Support to energy producers – such as through tax exemptions, reduced-rate loans, low rates of return requirements, and limitations on risk and liability – effectively lower producer costs. If, as in the former eastern bloc countries, the support leads to a reduction in the price the energy is sold domestically to below what the prevailing world market price would be without the support,²² removal of the support will result in

Table 4.3. **Estimates of total coal PSEs in OECD Member countries, 1993**

	PSE per tonne (\$/tce)	Total PSE (US\$ M)	Support %		Subsidised production Mtce
			On-budget	Price regulations	
France	43	428	100	0	10.0
Germany	109	6688	40	60	61.5
Japan	161	1034	12	88	6.4
Spain	84	856	37	63	10.2
Turkey	143	416	100	0	2.9
United Kingdom	15	873	2	98	57.4

tce = tonne of coal equivalent; Mtce = million tce (1 tce = 29,308 GJ).

Source: DRI (1997) and IEA (1994).

higher prices to consumers. Where the primary fuel used is coal, consumers may then reduce coal consumption either through switching to other, relatively cheaper, fuels or through implementing energy conservation or efficiency measures. If instead the support includes an element of price support, such as requiring power generators to purchase domestically produced fuel at a higher price than world market prices, support removal may result in lower prices for consumers. Any resulting increase in electricity demand that results from removing these supports might be met by coal imports or switching to alternate fuels.

Removing support for domestic coal production may lead to increased coal imports or switching to other fuels, depending on the relative prices of the alternatives. At current world prices, coal-based electricity generation generally has cheaper running costs than the alternatives. However, other fuels may have other advantages to producers which, together with expectations of future environmental regulations, may encourage users to switch away from coal. For example, the use of natural gas in combined cycle gas turbines (CCGTs) has a number of practical advantages over coal for electricity supply: it has low capital costs per kilowatt of generating capacity, high thermal conversion efficiency, short construction and start-up times, and an ability to be supplied as "turn-key" plant on a modular basis. It also has environmental advantages, including less land use and fewer emissions of pollutants, including half the CO₂ emissions of coal-fired plant per unit of electricity generated. As a result, it will become more competitive with coal as electricity and gas networks develop and transmission costs fall. One case study (Michaelis, 1997) on the effects of the recent restructuring of the electricity supply industry in the United Kingdom found that from the mid- to late-1980s gas

became significantly more competitive with coal for baseload power provision because of several key changes:

- *from the mid-1980s a new natural gas-based generating technology (CCGT) became available;*
- *the European Council repealed a directive that had limited the use of gas for baseload power generation; and*
- *UK commitments to reduce national emissions of sulphur and nitrogen oxides implied rising costs of coal-fired power generation because of the cost of emission controls.*

If, as in some countries, environmental regulations had already required the retrofitting of existing coal plants with scrubbers to reduce sulphur emissions at the time of this restructuring, the potential incentives to switch fuels might have been less, both because there would have been significantly more sunk investment in the power plant infrastructure and because the environmental gains from switching fuels would have been less.

In addition to supporting energy producers and downstream energy-intensive industries, a number of OECD Member countries also support domestic energy consumption activities. For example, residential electricity consumption is often supported through reduced VAT or sales taxes with the aim of improving the access of low-income households to electricity systems and because electricity and fuel taxation are viewed as having a regressive incidence (the share of energy costs in household expenditure decreases with rising household income). On the other hand, particular targeted support measures, such as energy efficiency grants or social security measures, are likely to be more efficient methods of achieving the social equity goals than across-the-board low energy taxes.

One of the case studies on federal energy support removal in the United States (DFI, 1993) found that the two types of support whose removal offers the largest CO₂ emissions reductions are support to utilities through low interest loans to rural utilities and the tax exemption of municipal utilities. By contrast, removing energy consumer supports to low-income households had little effect on carbon emissions. The UK (Michaelis, 1997) and Italian (Tosato, 1997) case studies found similar results, with removal of support to the electricity supply industry likely to have larger effects on emission reductions than the removal of support to consumers. The producer support measures with perhaps the largest potential environmental impacts are those that reduce the rate of return sought from electricity supply investments, such as support to investments, limitations on risk and liability, and rate of return controls associated with monopoly franchises. These supports may lead to greater environmental impacts than those that would occur merely through an equivalently high discount rate. For example, one study of the United States (Andrews and Govil, 1995) found that the protection of utilities from risk may have lead them to pay insufficient attention to the

Table 4.4. The effects of different fund recycling scenarios on GNP and welfare disparities among regions and household types from federal energy support removal in the USA

Fund recycling assumption	Effect on GNP	Effect on welfare disparities
Funds used to reduce <i>average</i> tax on earnings	Falls slightly (approx. -0.3%)	Increases
Funds used to reduce <i>marginal</i> tax on earnings	Rises slightly (approx. 0.1%)	Decreases
Funds used to reduce taxes on capital income	Rises slightly (approx. 0.2%)	Increases
Source: DJA (1994).		

potential for increasingly stringent environmental standards. As a result, these utilities tend to take inadequate environmental precautions.

Overall economic and employment effects of removing support measures

With the removal of budgetary support measures and tax expenditures, government will have more funds at its disposal. The effect on the economy will depend very much on how the government uses any such funds. One OECD case study on the removal of federal energy support measures in the United States (DJA, 1994) modelled the effects of recycling these funds into various types of general tax reductions. Table 4.4 presents the results under different assumptions about the recycling of funds.

Coal industry employment may fall as a result of removing support to coal production, but not necessarily. Where the support takes the form of compulsory purchase obligations by the electricity supply industry, removal of the support can result in lower electricity costs and higher demand. Whether the demand is filled by domestic coal, imported coal, or other fuels depends on a number of factors, including the relative prices of the substitutes. In addition, removing government support for an uncompetitive sector will also reduce the general taxation burden on other sectors, thus increasing employment possibilities elsewhere in the economy.

4.2.2. Decisive factors

Analysing the results of previous case studies

The results of the case studies, as described in *Reforming Energy and Transport Subsidies: Environmental and Economic Implications* (OECD, 1997a), vary strongly. This suggests that the environmental effects of support reduction depend on a number of factors, each of which may serve to reinforce or weaken the effects of the

others. As a result, an analysis was carried out to investigate in a qualitative way the decisive factors in determining the environmental effects of the support and the way they interact with each other. Following the template illustrated in Figure 3.1, the case studies have been summarised according to the format shown below in Table 4.5.

It was beyond the available time and budget constraints for this report to re-analyse these case studies and construct a quantification of the factors and

Table 4.5. **Template of decisive factors in explaining the environmental effects of energy support measures**

	Factors	Mechanisms explaining environmental effects of support reduction
Characteristics of support measures		
Support to producers	Conditions of the support; points of impact (inputs, value adding factors, income) Other regulations that interfere with the choices of energy producers	How and to what degree the support: • affects short- and long-term marginal costs of the recipient sector relative to its competitors; • shelters the recipient sector from competition by other means
Support to consumers	Whether the support includes: • regulated energy prices; and/or • purchase obligations	How and to what degree the support: • locks the consumer into using the supported energy types to the detriment of alternative energy sources; • affects the total volume of energy consumed
Characteristics of the recipient sector(s)		
Producers/consumers	Demand and supply conditions of the recipient sectors Input shares Substitution elasticities	The choices open to the affected sectors; substitution possibilities The potential environmental effects of the alternatives
Circumstances (determining the benchmark or base case scenario)		
Environmental Policy	Relevant present and expected environmental regulations	Environmental requirements, their associated costs, and their effects on actual emissions
Autonomous changes in technology and economy (markets)	Observed and assumed facts regarding the development of the relative costs of different types of energy, and other factors determining market penetration (scale effects, capital requirement, infrastructure requirements, etc.)	Effects of any assumed autonomous changes on the emission levels in the benchmark scenario

Source: OECD.

mechanisms described above. Instead, a qualitative analysis of the available information was undertaken (see Vollebergh, 1998 forthcoming, for a full description).

Decisive factors concerning the characteristics of support

On the supply side, support to *infrastructure* and to *capital*, such as through soft loans and low rates of return requirements, are effective in bringing down the *long run marginal user costs* and increasing demand over the longer term. The allowance of *insufficient provision for environmental liabilities* also reduces the long-term marginal user costs. Other regulations, particularly purchase obligations, have proven to be very effective in deterring other suppliers, especially from abroad. Reductions of these types of support will have predominantly long-term effects in terms of potential environmental benefits.

On the demand side, it is the effect of different support measures on the fuel mix, the total fuel demand, and the adoption of new technologies that will determine the environmental effects of the support. *Tax exemptions on fuels and other supports to industrial consumers*, in particular, will have a strong effect on the *long-term fuel demand*. The industrial sector is much more sensitive to these support measures than the household sector. Reducing these forms of support can have an immediate short-term effect as well, but to a lesser extent. These support and other regulatory measures are effective in influencing the fuel mix used. When they are used to protect relatively dirty fuels and associated technologies, and involve large volumes of production, they will necessarily have a strong detrimental effect on the environment, unless countervailed by other factors.

Countervailing and reinforcing factors

The analysis confirmed the importance of three factors that might counter or reinforce the effects of support measures on the environment. They are:

- *the availability of substitution possibilities in the recipient sector,*
- *the actual and expected environmental regulations, and*
- *the autonomous technological and economic developments.*

The case studies therefore found that fuel-switching had the largest effect on emission reductions. Consequently, the same change in user costs may have small or large effects on the fuel mix, depending on the availability of substitution possibilities in the short run. Such substitution possibilities are generally more abundant in the industrial and electricity generation sectors than in the household sector. If no practical and economically-feasible substitution possibilities exist in the short run, energy support measures will only be able to influence total levels of energy demand, not fuel switching. But total energy demand is inelastic

to changes in fuel price in the short run,²³ so support measures – or their removal – will be largely ineffective in influencing energy production and consumption patterns if there are no real substitution possibilities available.

Introducing stricter environmental standards (increasing both the long- and short-term marginal costs) will make any support to fossil fuels, especially coal, either less effective or more expensive to maintain. There will also be fewer environmental gains to be realised through the removal of the support measure if such stringent environmental standards are in place. Conversely, simultaneously adopting strict environmental standards and reducing support levels will reinforce the beneficial environmental effects of both policies.

The emergence of new technologies and markets often reduces the economic viability of the supported fuel even further over time. In such cases, either the effectiveness of the support will be reduced or the amount of the support administered must be increased to achieve the same socio-economic objectives. Again, if the support becomes less effective as a result of new developments, the environmental benefits of the support removal will also be more modest. As shown before (Section 4.2.1), some of the reviewed case studies found only relatively small environmental improvements. This was largely because the benchmark scenarios, against which programmes of support removal were compared, often already contained assumptions that the support measures would be reduced as a result of autonomous developments.

4.2.3. Policy conclusions

The support of indigenous production not only protects the supported domestic industry from external competition, but also serves to reduce incentives for innovation and technological development.

In the reviewed case studies, support removal was always found to have positive effects on the environment, except in the relatively few cases in which the support measures stimulated the adoption of cleaner technologies.

Support removal has the greatest impact if it is well targeted. That is to say, it should be directed at those support measures that influence the relative short- and long-term marginal costs of those sectors that have the greatest opportunities to change their fuel choices to less environmentally-damaging fuels.

Support removal and stricter environmental standards can be synergistic. Continuing support to relatively heavily polluting fuels is likely to reduce the political incentives to apply stricter environmental standards. This is because the higher costs of production that arise from stricter environmental requirements will reduce the effectiveness of the support in terms of achieving the same socio-economic objectives per amount spent on the support. If the UK, for example, had not already decided to phase-out coal support in the 1980s, then the need to

adopt stricter European environmental standards would have forced the government to dramatically increase its support to coal use if it were to maintain the same level of employment in the mining sector. Of course, the existence of support does not always result in lenient environmental standards, as studies of Germany and Japan illustrate.

A large part of support to energy producers in OECD Member countries is directed at upholding national coal production and electricity generation. Without this support, a large proportion of current coal production would shift to other countries and the total volume of coal production would probably decrease. In some cases, these supports have become very costly. However, political opposition to a reduction, let alone removal, of support to coal is often strong. This is because coal production is very regionally-based. The case studies under review did not examine whether the money spent on coal support could have saved more regional and national employment if it had been decoupled from production and spent instead directly on retraining or possibly even reducing labour costs in the affected areas on a temporary basis. Such an analysis could enlighten any discussion on the potential employment losses that might arise from support reductions.

4.2.4. Determining the downstream effects of removing support to energy in more detail

The case study “Effects of Government Subsidies on the Environment: The Case of Electricity and Newsprint Production from a Swedish Perspective” (Normann, *et al.*, 1998 forthcoming) gives further quantitative evidence on many of the key issues under study by analysing the effects of removing tax exemptions to energy production and use in Sweden. The study examines some of the economic and environmental effects of subsidy reform or removal to a downstream industry, in terms of material substitution and production changes that would occur in the newsprint industry. In particular, the substitution between two available production technologies – the energy-intensive TMP process which uses virgin pulp, and the less energy-intensive de-inking process (DIP) which uses recycled pulp – is explored.

The study investigates how the level of newsprint production and the processes used, with their associated air emissions, would change if the electricity producers and the newsprint industry were obliged to pay the same CO₂ and electricity tax rates as other sectors of the Swedish economy. These exemptions exist to protect Swedish industry against competitors from countries where such taxes are levied at lower rates or do not exist at all.

The study finds that the effects of the increase in taxation on the short-run marginal costs of electricity production would be quite significant, with the margi-

nal effective tax rate (or rather the marginal effective rate of policy impact, since effects of regulations are included) estimated to increase by almost 70 per cent. Such a policy would lead to a decrease in the profitability and competitive position of Swedish newsprint production, though more so for the energy-intensive process (TMP) than for the less energy-intensive one (DIP). Overall, Sweden would be expected to lose a significant proportion of its newspaper production to producers in other countries. This would lead to reduced energy demand in Sweden, which, at the margin, is supplied by relatively highly-polluting oil and coal-fired plants from the integrated Nordic electricity market in most cases.

If the newsprint production is shifted primarily to countries who use the TMP production process fuelled by particularly polluting electricity production compared with the Nordic production it replaces, the global environmental emissions (particularly of SO_2 and NO_x) might increase as a result of the shift. This would not happen, however, if newsprint production shifted to densely populated countries such as France, Germany and Great Britain, and the DIP process was used fuelled by combined cycle gas turbines (CCGT). In such a case, global emissions would be expected to fall.

Emissions in neighbouring countries would generate pollution that would partly fall in Sweden. In both the high emission and low emission scenarios examined, however, the pollution reductions within Sweden from production moving abroad are greater than the increases in pollution that would enter Sweden from these operations. Therefore, the pollution levels in Sweden would be reduced as a result of such a policy, although global pollution might worsen depending on the technologies used in the countries to which production shifted.

Among the factors determining the potential environmental impact of the policy change are the effect of increased energy taxation on the marginal effective tax rate on energy use and the significant difference in energy intensity of the two alternative processes. Even more important was, however, the assumptions used about both the environmental effects of the production processes in other countries and the openness of the Swedish economy.

The study illustrates the need to analyse changes in support or taxation regimes at the margin, and to estimate both the short- and medium-term effects. It also indicates the existence of a prisoners' dilemma situation: if all countries were to join in a policy to increase taxes on electricity and CO_2 emissions, the harmful effects a unilateral action would have on the implementing economy would be avoided since local demand for the commodity would not decrease significantly. At the same time, a significant shift could be expected towards the more environmentally-friendly DIP production process, with a net benefit for all. However, if such a policy is not adopted by other countries as well, Sweden would only be able to introduce these tax increases (*i.e.*, reduce the current tax expenditures) at a significant loss to the international competitiveness of its industries.

4.3. TRANSPORT

4.3.1. Lessons from the literature on the environmental impacts of removing support to transport

Policy Reform

In recent years most OECD Member countries have been increasing taxes and charges on transportation activities, largely because transportation is a relatively stable tax base for raising revenues. Some countries have also introduced additional taxes on transport to partially internalise the costs of environmental externalities associated with different transport modes and in order to influence the modal split. With increasing international commitments to reducing greenhouse gas emissions, the internalisation of the external costs of transport usage is becoming a greater priority for most governments. These two policy objectives of raising revenues and internalising environmental externalities are applied in the transport charging systems of OECD Member countries to varying degrees and in a range of different ways.

In addition to supporting transport activities through non-recovery of the full costs of providing transport infrastructure and related services, governments have also intervened in transport markets through ownership and regulations that either restrict or require transport activities to take place that would not have under free market conditions. While some of these regulations are necessary for maintaining safety and environmental standards or other policy objectives, others may be unnecessarily restrictive and can inhibit the efficient use of transportation resources. The recent trend in liberalising transport activities has increased competition within and between transport modes, leading to a general increase in efficiency and innovative practices. For example, the liberalisation of rail freight in the United States in the 1970s led to a significant increase in energy-efficiency in the sector (OECD, 1997f).

In order to better understand the effects of support measures on transportation use at the country level, some studies have evaluated the balance between annual government spending on road building, maintenance and services on the one hand, and the level of fees and taxes paid by road users to government on the other. In this way, a comparison can be made between the road-related taxes and charges collected by the government and the quality and amount of road infrastructure and services they provide in return. A rough measure of the net support to road users can be considered as the difference between the two. Utilising this methodology, the OECD undertook three case studies to examine the impacts of removing road transport subsidies through introducing full-cost pricing for road users in France, Japan and the United States. In addition, all three case studies evaluated the level of externalities that arise from road usage and calculated a new support balance including these costs on the expenditure side

of the equation. As many countries have started applying charges and taxes to internalise these externalities on the revenue side of the equation, some balance is also needed for the expenditure side in order to accurately calculate the true levels of support.

Environmental linkages

There are a number of ways transport activities impact on the environment. All stages of transport use – from the construction of transportation infrastructure and vehicles, to the use and fuelling of the various modes of transport, to the disposal of vehicles and related equipment – have environmental effects. These include impacts on: *air quality*, including substantial emissions of greenhouse gases (CO₂ and CFCs) and local air pollutants (CO, HC, NO_x particulates and fuel additives such as lead); *noise pollution*; *land use*, including the use of land for transport infrastructure provision and the extraction of road and other infrastructure building materials; *waste disposal*, especially the disposal of road works rubble, old vehicles and used tyres; and *natural ecosystems*, through the pollution of water and ground systems, and the partition or destruction of farmland and wildlife habitats.

The types and magnitudes of environmental damage that result from transport activities varies according to the mode of transport used, as well as the fuels and technologies used in any single mode. The average external costs (*i.e.*, those associated with transport accidents, noise pollution, local air pollution and greenhouse gas emissions) of road and rail usage for passenger and freight activities have been calculated for ECMT countries (ECMT, 1998). With the exclusion of passenger noise pollution levels, rail was found to contribute significantly *less* to all of these externalities than road transport for both passenger and freight use.

The environmental costs of support

Support to transport lowers the costs of transportation and encourages transport activities to take place at a level greater than they otherwise would. Because transport is a major contributor to environmental problems, particularly local and global air pollution, any increase in usage that arises from support to transport increases the detrimental effects on the environment. Where cross-subsidies exist between different transport modes or transport user groups, more polluting activities may also be favoured relative to less polluting ones. Support is often given to public transport in order to encourage its use on the assumption that it results in lower environmental impacts compared with private transport. This is a second best alternative to internalising the social costs of private transport.

The three OECD transport case studies all estimated the total external costs of road transport in their respective countries, though with some variation in the

types of damage examined and the methods used for calculating the costs of damage (Table 4.6). Any calculation of the external costs of road transport will be subject to considerable uncertainty. As a result, the United States study calculated both high and low estimates for the costs of external damage.

Given the variations in defining and calculating the costs of road externalities, and the differences in local circumstances, the *total* external costs per vehicle-kilometre appear remarkably similar across the studies. The estimates for the external cost components differ considerably.

Table 4.7 below shows a breakdown of estimated road-related revenues and expenditures for the three countries, including the estimated costs of externalities.

These figures indicate that the external costs of road transport are substantial, significantly exceeding the total of all road-related government expenditures in both France and the United States. France is the only country of the three examined where road-related revenues actually exceed road expenditures (*i.e.*, there is full cost coverage). However, when the external costs of transporta-

Table 4.6. **Comparison of external unit costs of road transport in case studies^a**

Unit = cents per vehicle-km

Items	Japan	USA		France
		Low	High	
Noise	0.49	0.12	0.19	0.35
Vibration	—	0.01	0.01	—
Air pollution	1.9	0.38	5.75	0.89
Accidents	0.14	1.58	1.58	1.06
GHG emissions	0.61	0.05	0.19	0.53
Elimination of natural areas	0.001	—	—	—
Subtotal	3.14	2.14	7.72	2.83
Congestion ^b	—	1.23	2.8	—
Congestion to public transport and pedestrians	—	—	—	0.89
Total external costs	3.14	3.37	10.52	3.72

a) The studies differ in the methodologies used for calculating external costs, the types of externalities included, the assumptions used, and the local circumstances existing in the countries examined.

b) Whether, and to what degree, congestion arising from transport usage should be classified as an externality is open to debate. Congestion results in an extra cost from extra time spent travelling, but this cost is generally borne directly (internalised) by the transport users. However, the effects of road congestion arising from private road use on others (public transport users and pedestrians) may represent a non-internalised cost. As a result, road congestion pricing is generally justified on the grounds of economic efficiency, not as an intention to internalise a potential external cost.

Source: As cited in Morisugi (1997).

Table 4.7. Road revenues as % of road expenditure with and without the external costs included for France, Japan and USA in 1991

	France – urban (billion FF)	France – rural (billion FF)	Japan (billion ¥)	USA (million US\$)
Revenues	57.0	100.2	9 530	62 747
Expenditures	44.2	61.2	11 665	78 260
Balance	+12.8	+39	–2 135	–15 513
Revenues as % of expenditures	127%	164%	82%	80%
External costs ^a	56 to 92.7	33.8 to 48.2	2 742	117 800 to 371 700 ^b
Balance – external costs	–43.2 to –79.9	–9.2 to +5.2	–4 877	–356 187 to –102 287
Revenues as % of expenditures + external costs	42 to 57%	92 to 105%	66%	14% to 32%

- a) External costs for the different studies included costs associated with:
 For France – local and regional pollution, greenhouse gas effects, congestion, accidents, and noise.
 For Japan – pollution, greenhouse gas effects, accidents, noise, and the elimination of natural areas.
 For the USA – the effects of air pollution on human health, materials and crops; climate change; congestion; accidents; noise; and vibration.
- b) These estimates for external costs do *not* include tax exemptions for employee parking provision. These totalled an estimated US\$19 billion.

Sources: Haltmaier (1997), Morisugi (1997) and Orfeuil (1997).

tion are considered, all three countries are found to be significantly supporting transport usage, with the possible exception of rural road users in France. According to economic theory, the price of a unit of transport activity should equal the full marginal social costs of the transport if these prices are to reflect the full costs of providing this service and thus give the right signals for the socially optimal use of transport. Thus, both the private and the social costs of transport should be internalised in the prices paid for these activities.

Cross-subsidies between different road users are also significant in many OECD Member countries. Table 4.8 shows a breakdown of the French and UK road-related expenditure coverage by vehicle class. When external costs are excluded (as for the UK study), these figures again show very high revenue-to-expenditure ratios. Both studies indicate significant cross-subsidies from cars and light trucks to heavy trucks. Thus, commercial transport users have been found to be subsidised by private passenger transport users. The French data also shows large cross-subsidies from rural to urban road users and from gasoline-powered vehicles to diesel-powered.

The environmental benefits of support reform or removal

The three OECD case studies also estimated some of the environmental benefits that might result from raising road transport prices to reflect the full costs

Table 4.8. **Road related revenues as % of expenditure by vehicle class, UK 1989 and France 1991**

Vehicle class	UK %	Vehicle class	France – urban %	France – rural %
Cars/light vans	340	Two wheeled vehicles	15-19	39-44
Motorcycles	330	Cars – gasoline	56-76	125-140
Buses and coaches	110	Cars – diesel	27-36	66-72
Good vehicles over 1.525 unladen:		Light trucks – gasoline	46-67	106-120
Not over 3.5 tonnes GVM	310	Light trucks – diesel	26-37	74-84
Over 3.5 tonnes	130	Heavy trucks	24-32	68-84
Other vehicles	240	Buses	44-70	104-132
All vehicles	260	All vehicles	42-57	92-105

Sources: UK: OECD (1992b), France: Orfeuil (1997).

of road expenditures and the external costs of road usage. The French case study calculated that fuel taxes would need to be raised by 50 per cent in order to reflect all external costs, a policy that might be extremely unpopular politically. If it was undertaken, however, the study estimated that traffic levels and the levels of most externalities would be reduced by about 15 per cent, with greenhouse gas emissions from road transport falling by 35 per cent. Japan also found that raising fuel taxes to cover both expenditures and externalities would result in a large reduction of CO₂ emissions, by an estimated 11 per cent by 2010 (equivalent to 29 million tonnes). Approximately half the reductions would result from reduced driving levels, and half from increased fuel efficiency.

The US case study modelled two potential scenarios for partially internalising the costs of road expenditures and externalities: one scenario where this was achieved through the use of increased fuel taxes alone, and one where a mix of pricing instruments (congestion pricing, parking charges for cars, and axle weight charges) were used. The first scenario would result in an estimated reduction of road-related greenhouse gases of 15 per cent by 2010, while the second found a reduction of 12 per cent. However, the second scenario with its mix of pricing instruments was found to be both more economically efficient and resulted in a larger reduction in peak period traffic, with which many of the other externalities are highly correlated.

Thus, all three studies estimated that reducing support to road usage through the coverage of the full marginal costs of use and internalising the external costs of transportation could significantly contribute to a reduction in greenhouse gas emissions as well as other transport-related externalities.

4.3.2. Marginal effective tax rates on competing modes of freight transport

As yet, there is no standardised measure for calculating the level of distortionary support to the transport sector. In lieu of such an indicator, a number of studies have compared the annual road-related revenues collected under government budgets with the road-related expenditures as shown above. However, this is not a very satisfactory tool for guiding policy decisions as it is only able to indicate whether full cost recovery is occurring, not how pricing systems would need to be changed to achieve economic efficiency. Such calculations do not identify the types of support measures in place that lead to any imbalance that is found, nor who gains from and who pays for the support.

These analyses are also problematic in that governments levy charges or taxes on transport use for other purposes than to balance the funds spent on providing transport infrastructure, maintenance and services. For example, transport usage may be taxed or charges levied in order to internalise the external social costs of transport use. A typical “balance sheet” would then equate the transport user charges plus payments for external damage²⁴ (the “revenues”) against the infrastructure expenditure plus the costs of the actual environmental damage (the “expenditures”). Unfortunately, while these “payments for external damages” are easily included in the transport-related revenues wherever an environmental tax or charge is levied, the corresponding “costs of the actual environmental damage” will seldom be considered in the transport-related expenditures. This can give the potentially false impression that transport-related revenues more than cover expenditures. Unfortunately, disentangling the charges and taxes which are intended to internalise the social costs of transport from the other taxes and charges is a very difficult task.

Thus, the methodology of comparing transport-related revenues and costs that is used in the case studies discussed above leaves a number of important questions unanswered. In particular, it is not able to examine how changes in transport taxation levels might affect total transport demand or what effects differing taxation levels on different modes will have on the modal split of transport. In order to start to answer these questions, a case study (Pillet, 1998 forthcoming) was commissioned to look into the effects of taxation on the relative marginal costs of different modes of freight transport (road, rail, air and inland shipping – where appropriate and where data was available) in four European countries.²⁵ Assuming that relative prices are determined by marginal costs, *the effects of taxation on marginal costs* were calculated in order to better understand the effect of different taxation levels on the supply of freight transport services. The study set out to analyse the degree to which transfers conditional on specific inputs (labour, capital, or fuel) may vary in their effects on the marginal costs of different modes of transportation. As such, it is the first step towards analysing

how effective changes in the relative prices of inputs to the different modes of transport might be in determining the modal split.

The analysis drew on an inventory of road taxes and charges for the four European countries under examination that was conducted for the Conference of European Ministers of Transport. These taxes and charges were then converted into measures of marginal costs. Next, these were then weighted based on values for a standardised haul and then combined to yield an estimate of the marginal effective tax rate (METR) for each transport mode for each country. This statistic reveals the effect of taxes on the price transport providers would command for the next haul. As shown in Chapter 3 of this report, however, taxes imposed on the previous stages of production will generally be split between the suppliers and the purchasers of the goods or services under consideration. Thus, fuel taxes, for example, will lead to higher fuel supply costs, only some of which will be transferred on to fuel consumers. Because of the lack of available data, the case study was unable to consider this leakage effect of the taxes.

The results revealed large differences in the marginal effective tax rates between the neighbouring countries for all modes of transport. What is more relevant for analysing the potential environmental effects of changes in taxation is that large differences in the METRs were found between the different modes of transport within each country as well. Rail freight was found invariably to be taxed lightly (probably in comparison to other economic activities as well), road freight was taxed relatively highly (but probably not more heavily than other economic activities), and air freight was taxed somewhere between road and rail.²⁶ As discussed above, rail transport is significantly less polluting than road transport and, as such, should be taxed less than road if the external costs of transportation are to be internalised in the activities. However, determining the appropriate size of the taxation differential is more difficult. The same argument holds for levying lower taxation rates on public transport than on private transport, in that public transport is considered to have fewer external environmental and social effects than private transport.

The decisive factors in influencing the marginal rates of taxation for the different transport modes were the large differences in taxation rates (and tolls where applicable) and the (smaller) differences in input shares to the marginal costs. It is unlikely, however, that these differences in marginal rates of taxation have been very influential in determining the division of transport activities between the different transport modes. The large differences in taxation rates have probably been in place in most countries for a long time. Yet, the much larger marginal effective tax rate on road freight transport as compared with rail has not prevented the increase in the market share of road freight and the associated decrease in rail. This would seem to indicate that a much larger taxation differential between the two modes would be required to encourage a

shift towards the more environmentally-friendly rail transport through taxation differentiation. As a result, it may be easier to achieve any desired changes in the modal split through infrastructure decisions and improvements to the quality of rail transport services.

4.3.3. Decisive factors

In the different methodologies used to estimate the levels of support to transport activities (or proxies for them), different factors can be identified which were found to be decisive in determining the environmental consequences of the support measures.

Decisive factors in determining fuel and vehicle choices

Changes in the costs of transport services can lead to quite significant adaptations by transport users in order to avoid costs. Thus, significant responses to price increases have been found, particularly with respect to changes in the price of transport inputs. For example, higher petrol prices during the oil shocks of the 1970s and higher fuel taxes in more recent years have stimulated increased fuel efficiency, consequently reducing the emissions of many pollutants per tonne (or passenger) kilometre quite dramatically. Tax differentials between leaded and unleaded petrol or tradable permit schemes, combined with regulatory policies such as exhaust-emission and fuel-quality standards, have virtually eliminated lead emissions from road vehicles in many countries (EUROSTAT, 1996). While road users respond to some extent to increased input prices and price differentials by increased fuel efficiency and fuel switching, these changes are often realised only in the medium to long-term as they often require vehicle replacement. However, despite the rising taxes on fuels in the European Union and many other OECD Member countries, the price of fuel relative to disposable income has fallen steadily since 1980, with a concomitant increase in total fuel consumption.

Decisive factors in determining total transport demand and modal split

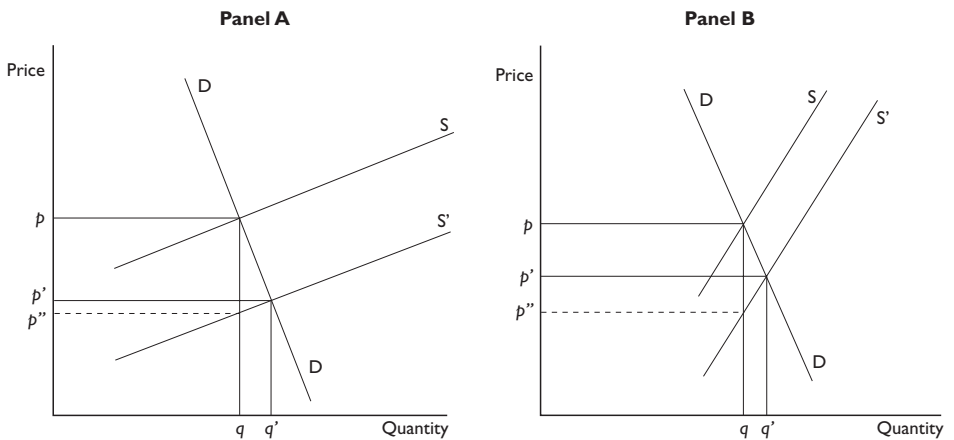
The demand for transport depends strongly on the volume of economic activity (notably production and trade), the availability and quality of transport infrastructure, and the location of business activities. Moreover, with respect to freight transport, the transportation costs generally constitute only a small proportion of the total costs of the finished goods. Not surprisingly, the demand for transport is often found to be fairly insensitive to changes in transport prices (*i.e.*, there is a low price elasticity of demand). It appears that decisions on the choice of transport mode used is also quite price inelastic, depending to a large

extent on other factors instead, such as speed, punctuality and reliability – in short, the quality of the transport service.

As stated above, in many cases the demand for transport services is insensitive to price changes. Since increasing the capacity of road freight requires relatively modest new investments, assuming that the roads have been built, the supply of road freight can be expanded at relatively low costs (see Panel A of Figure 4.1). In comparison, it would be expected that rail, shipping and air transport would have steeper supply curves because of the higher costs of each additional unit of transport supplied (Panel B).

This has important consequences for the effect of a support measure, or a change in the marginal effective tax rate, on the different modes. Suppose that road hauliers receive a tax break of $(p - p'')$, which shifts the supply curve to the right, from S to S' (Panel A). Then the new price for the freight service would become p' . From the graph it can be seen that much of this support $(p - p')$ would be leaked to the users of the road freight services, rather than accruing to the freight suppliers. Consider instead the situation where the short-term supply curve is steeper (Panel B), as might be the case for rail transport. In this case, a support measure that shifted the supply curve so as to affect the same price difference between p and p'' , would probably lead to a smaller actual decrease in the price offered to purchasers of the freight transport services $(p - p')$, and,

◆ Figure 4.1. *The role of price elasticities in transport*



Marginal effective tax rates (METRs) on passenger transport in the USA and Canada

McKenzie, *et al.* (1992) examined the tax differentials on different modes of passenger transport in Canada and the United States to better understand the effects of the tax systems on the inter-modal and international competitiveness of the transport activities. To the extent that the effective tax rate on the marginal costs of providing transportation differs across the transport modes, or for a mode between different countries, the taxation system affects the ability of these modes to compete with each other. In order to calculate the METR for each mode, the authors calculated the effective tax rates on the marginal costs of the relevant inputs – fuel, capital and labour – and then combined them using a Cobb-Douglas production function.

Effective tax rates on marginal cost of passenger transport and marginal effective tax rates on inputs

	Canada			USA		
	%			%		
	Rail	Bus	Air	Rail	Bus	Air
Input shares^a				As for Canada		
Labour	41.1	42.5	27.4			
Fuel	8.6	8.4	18.1			
Capital	50.3	49.1	54.5			
Marginal effective tax rate on						
Labour	5.4	4.2	5.6	9.5	9.5	9.2
Fuel	38.3	63.3	32.0	8.6	44.7	5.6
Capital	33.0	30.9	22.6	28.5	25.1	19.5
Effective tax rate on marginal cost	21.3	21.0	19.3	18.6	19.7	14.0

a) Input shares were based on transportation statistics of the Canadian Royal Commission on National Passenger Transportation.

Source: McKenzie, *et al.* (1992).

As can be seen from the results above, the Canadian taxation system is almost neutral between different transport modes, whereas in the United States the taxation system significantly favours air transport over rail and bus. The overall METRs are slightly lower in the United States than in Canada, implying an overall competitive advantage for United States passenger transportation companies. Although the effective tax on labour is lower in Canada, the effective fuel tax is substantially lower in the United States, particularly for rail and road. While it is

(continued on next page)

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the total prices and services offered by the transport companies that will determine the demand and modal split, differentials in the effective tax rates on the marginal costs of the modes will influence their relative price competitiveness.

consequently, less leakage of the support to customers. Consequently, the increase in the volume in road freight transport demanded as a result of the support measure would be small, and so too would be its environmental effects.

4.3.4. Policy Conclusions

Transportation activities continue to be supported in OECD Member countries. Much of this support takes place through the provision of infrastructure and services below cost. In addition, many of the social and environmental externalities associated with transport activities are not internalised in the pricing structures. Studies indicate that these externalities are extremely large and may even exceed direct government expenditures on transport.

It is important that support removal is accompanied by comprehensive regulatory reform, both within any transport mode and between modes. Within a mode, if support is removed without reforming other regulations which lock-in particular technologies or products or which limit competition, the potential environmental benefits of support removal will be countervailed. In addition to removing such regulations, it will be essential to examine whether any other regulations should be introduced which could more directly limit the negative environmental or social effects of transport activities.

In order to create similar competition and efficiency incentives across all modes of transport, it is best to liberalise all modes simultaneously. In addition, concerted action should be taken in the application of any accompanying social and environmental regulations, including transport-related taxes, so that particular modes do not realise an unfair competitive advantage through such differences. This has not been the case in many countries, with the liberalisation of rail and water-based transport often lagging behind road and air. The reform or removal of support, and the timing of when internalisation measures are introduced, must make allowance for these differences if unwanted modal transfers are to be avoided.

Within a free market area, it can be beneficial to harmonise transport regulations between countries, as well as between modes within a single country.

Without the harmonisation of charging systems, and environmental and safety regulations, it will be more difficult to agree to, or realise, the full benefits of transport deregulation. However, harmonisation can lead to a decrease in the environmental quality of some of the participating countries. For example, the European Union introduced a policy of using “average” values to harmonise transport regulations in its member countries, so those countries with stricter than average social and environmental regulations were required to reduce them as a result (OECD, 1997*e*). Although a system of multiple standards is theoretically possible, it can be difficult to maintain in an open market.

Given the low elasticity of total transport demand, it is likely that very large marginal costs of private transport use would be required to decrease demand or to increase public transport usage. Similarly, in order to encourage a gain in the market share of transportation undertaken by the less environmentally-damaging transport modes (rail and waterways, for example) would require even larger differences in the marginal effective tax rates on the various modes than those that already exist. In order to achieve such goals, pricing instruments would therefore have to be combined with other government policies including, for example, policies to reduce (or limit the expansion of) road infrastructure provision as part of a comprehensive integrated transport policy.

5. IMPLEMENTATION STRATEGIES

5.1. RESOLVING EQUITY CONCERNS

The majority of support measures under examination are supports to production that have been introduced to protect the employment and incomes of workers and farmers against the effects of foreign competition, especially in poorer regions. Many of these schemes have become more expensive over time in terms of support per worker, up to such high levels in some cases that they surpass the average income levels of the supported workers.²⁷ Moreover, the support may accrue primarily to the larger producers, thus leading to a regressively skewed distribution of the support. Since this support has to be paid for by taxpayers, the consumer, or both, the issuance of such support raises equity concerns in itself. Either consumers pay artificially high prices for the supported goods, as with minimum price support policies such as those used in the European Common Agricultural Policy, or the government supports the industry through direct payments or tax exemptions and reductions. When the consumer carries the burden of the support, there may be adverse distributional aspects. In particular, if it is a necessary good whose producers are supported, the excessive prices paid by consumers may have a regressive distributional impact, with lower income groups spending a larger portion of their income on the extra costs of the good than higher income groups. In such situations, support removal can result in a progressive distributional effect on consumers. If the government funds the support instead, then the support will have a negative effect on the budget. How the government would recycle these funds if the support were removed will have a strong bearing on the distributional effects of the support removal. The funds can be recycled either through

- *revenue neutral recycling* – reducing other taxes without altering the overall budgetary balance;
- *reducing the budget deficit* – this would reduce the debt burden on future generations as well as possibly increasing confidence in government policy and in the economy as a whole, thereby creating conditions for reduced interest rates and increased investment; or
- *targeted compensation packages* – for those who would suffer most from the support reform or removal.

While in many situations, reducing or removing support to industry will result in reduced incomes or even employment losses, these equity effects need to be carefully determined and a balanced examination made of the equity benefits that might arise to consumers and taxpayers from reducing the support. As was shown in the analysis above, although support levels given to an industry may be very high indeed, often only a small portion of this remains with the intended recipients. Of course, when examining the social benefits of maintaining the support measure, it is important to identify how much of the support actually stays with the intended recipients, and how this alters their relative position in the economy.

Continuing traditional support to ailing industries may merely delay, often at increasing budgetary and environmental costs, the exposure of the industries to external competitive pressures and developments. While removing the support may lead to employment reductions and, potentially, the demise of the industry, in some situations the application of well-directed implementation strategies can assist the industry in developing its competitive position, rather than simply protecting it from increasing competitive pressures. For example, temporary support conditional on the application of technologies and practices that are environmentally superior to existing ones can be used to help an industry that is economically and environmentally viable to overcome a transitional period of low competitiveness. Such support was used successfully in Austria to rejuvenate an ailing pulp and paper industry which the government had been supporting for many years. The Austrian government decided to redirect the support in the late 1980s to the implementation of new, and more environmentally-friendly, technologies (Obersteiner, *et al.*, 1998 forthcoming). With the help of this temporary support scheme, the Austrian pulp and paper industry became more competitive, and thus able to sustain itself, and less environmentally-damaging. Of course, with such measures great care must be taken that the industry does not become dependent on the support or that the support is not extended endlessly.

If it is determined that a support measure should be reduced or removed, and this is expected to have negative employment and income effects, there are a number of ways compensation can be paid to those that will suffer from the loss of the support. These measures will be most effective and least likely to continue the environmental damage the support encouraged when they are temporary in nature, are decoupled from the levels of inputs or outputs, and are not linked to environmentally-harmful production processes. The main implementation strategies which have been suggested for redressing these equity concerns include:

- *Temporary compensatory payments, support that is decoupled from output levels:* They may be personal entitlements, but can take other forms as well, such as funds towards retraining programmes or even temporary support for the employment of redundant workers. In general, these payments ease the

transition towards economic structures that are better able to compete on the international markets, while avoiding the hardships of sudden and large income losses. In agriculture, however, some countries have developed compensatory payments that are dependent on the previous revenues of the farm. Although these payments are intended to compensate for lost revenues, if they are given on an ongoing rather than on a temporary basis, they also tend to lock-in the elements of the production process that led to the past revenues on which the compensatory payments are based. Where these elements were environmentally-harmful, such as the excessive use of irrigation systems and fertilisers, the harmful processes are likely to be continued under the compensation system.

- *Other compensation:* Adjustments can be made to the existing social security, fiscal or other systems – depending on national policies and priorities – to counter any potentially inequitable effects of support removal. However, since these adjustments tend to be permanent rather than temporary, they are often not suitable for compensation that is intended to ease the economic hardship of previously supported workers over a transitional period. Instead, they may be the result of recycling funds which were previously allocated to the support, in a manner which has a beneficial effect on the previous recipients of the support but also on others in the economy.

In general, it is preferable that compensatory measures which are introduced to ease the transition of workers in previously supported industries are temporary, fixed-term measures, only renewable under extenuating circumstances. Longer term measures will constitute both a drain on the budget and a distortion in the economy.

5.2. RESOLVING INTERNATIONAL COMPETITION ISSUES

Loss of competitiveness: The Prisoners' Dilemma

Countries that seek to reduce support to those industries that produce internationally-traded commodities may risk reducing the competitiveness of the affected sector, and even perhaps the country, in the international arena as a result. This is particularly the case where other countries also support the industry under examination. A "prisoners' dilemma" may arise whereby it is in the interests of all countries to remove their support together, but if any single country removes its support without the others doing so, that country may be worse off than if it had left the support in place. At the same time, the other countries may have benefited from the reduction of support in the first country by increasing their competitive standing relative to that country. Under such conditions, no single country will be willing to reduce support without the assurance that the other countries will also do so.

However, “pure” prisoners’ dilemma situations are rare in international relations. For such a situation to exist, two conditions must be fulfilled:

- *a single country taking the initiative on its own would suffer a welfare loss, and*
- *a collective international action would leave all participating countries better off.*

It is unusual for both these conditions to hold with respect to the support of national industries. Often the first condition may be violated because the individual country could realise a net benefit internally through taking unilateral action to reduce support, although it may not be apparent politically that such a net benefit would be realised. With respect to the second condition, there are often strategies which, if undertaken by all countries, would lead to a net aggregate increase in social welfare across the participating countries but may leave some individual countries worse off. In such cases, there are potential solutions that can be negotiated at the international level, including either proceeding without the losers if net benefits can still be realised through such action, or the use of side payments or sanctions to induce the “losers” to co-operate. The study on “Competitiveness and Reduction of Support Measures to Industry: The Prisoners’ Dilemma” prepared by Verbruggen and Oosterhuis (1998 forthcoming) analysed the two conditions of prisoners’ dilemma situations in more detail with respect to support removal for internationally-traded commodities and issues of competitiveness. Their main findings are summarised below.

The effects of a unilateral removal of support

Assuming the absence of any market distortions in a country (other than the subsidy itself), a reduction in support levels within the country will generally improve allocative efficiency and increase the country’s overall welfare, rather than decreasing it, *even if all other countries maintain their subsidies*. Only in a situation where the country’s policies affect the world market prices (as, for example, the agricultural policies of the United States and the European Union do) will the decline in production of the formerly supported industry lead to price increases on the world markets. This will provide “windfall profits” to foreign producers at the expense of producers and consumers in the country which reduced the support. If factors of production are mobile, they may then shift to countries where support and taxation regimes are more favourable.

In many cases, however, countries do not influence world market prices, so unilateral support removal will lead to net benefits for the country involved, regardless of what the rest of the world does. Given this, one might wonder why subsidies tend to persist in so many countries. One theory has been developed based on the assumption that political leadership behaves so as to maximise its chances of remaining in office. Thus, many policies can be seen as exercises to obtain and maintain political support. Anderson (1995) finds that the support

policies most likely to be observed in any country are those that deliver large and concentrated benefits to well organised groups, but impose costs on larger, less organised groups in a dispersed way such that each loser only loses a little relative to what each winner gains. The supported industry can also put aside some of the “rents” that accrue to them through the support for political lobbying to ensure the support is kept in place. Of course, not all of the support will stay with the recipient sector. Instead, some will be leaked away to the upstream and downstream industries with the strongest (market) power. This creates an incentive for these industries to lobby for the continuation of the support measure as well. Even if overall welfare would increase in the country through unilateral support removal, the political influence of the losers may outweigh that of the winners and can thereby create the impression that the support removal would be economically harmful overall.

For the majority of cases, the reform or removal of distortionary support measures will increase a country's welfare. It is only when the country's actions may have an impact on world market prices that welfare may decrease instead. Thus, in general, the first condition of the pure prisoners' dilemma situation will be violated and a single country which unilaterally reduces support will often realise a net gain from doing so, regardless of the actions of other countries. However, differences in the political influence of the support beneficiaries and losers may lead to a contrary perception, *i.e.*, that unilateral support reductions will lead to a net loss within the country implementing them. Depending on the mobility of the various factors of production, different prisoners' dilemma situations will arise, with different winners and losers as a result.

The effects of a multilateral removal of support

When support measures are removed simultaneously by all countries, one may expect that this will lead to welfare gains for most of them. Only countries with a strong comparative disadvantage for the production of the good (the net importers) may be net losers if they are confronted with higher prices on the world market. However, this effect will only be serious if the supply on the world market for the product or service is inelastic. Likewise, if support to inputs are removed, countries which are net exporters of those goods may suffer a net welfare loss, but only if the demand for these inputs on the world market is inelastic. Thus, empirical evidence on the world-wide removal of protectionist food policies found that there would be large net global welfare benefits of over US\$100 billion from the removal of these policies with only a few regions, primarily North Africa and the Middle East, suffering small net welfare losses (Anderson, 1992).

However, things look different when we consider the *perceived* welfare losses from support reduction. Although a particular country might realise a net benefit from the support removal, if the previously-supported sector realises a net loss and if this sector is represented by a powerful political lobby group, it may appear as though the country would realise a net loss from the support removal. As in the case of unilateral policies, support removal may result in net gains for the economy but a net loss for the previously supported industry. In the multilateral case, however, the losses are likely to be much smaller and the gains larger. International co-operation, therefore, may be essential to overcome the resistance of the supported industry, as well as to realise the larger gains for the country as a whole.

5.3. TRANSPARENCY

In order to have an informed policy debate on the desirability of support measures, it is essential that fiscal policies and support measures are as transparent as possible. Practices in OECD Member countries differ strongly in this respect. Perhaps the first necessary step in increasing the transparency of support measures would be to establish comprehensive, internationally-comparable data on the support levels and types in place. Unfortunately, there is currently only internationally-comparable data available for a few sectors – primarily agriculture and, to some extent, energy. Data on tax expenditures are scarce and inter-country comparisons on them often suffer from large differences in their definitions.

Such data would be beneficial both domestically and in international trade relations. Domestically, such information is crucial for raising the awareness of both those who pay for the support measures and the government on the full costs of funding the support. As discussed above, because of the nature of support measures, the beneficiaries of the support are often more visible than the losers and the benefits easier to calculate than the costs. Increasing the transparency of support can help to redress this balance. Increasing the available information on the type and impact of support measures in place will also contribute to an understanding of the effectiveness of the measures in achieving their economic or social goals and what environmental effects they might have.

In the international arena, increased transparency and internationally-comparable data on support measures is essential for co-operation in reducing barriers to trade and liberalising markets. Transparency in support measures is a precondition to resolving any prisoners' dilemma situations which arise in international trade situations, as well as identifying when such situations are only perceived prisoners' dilemmas. This will especially be the case with respect to

commodities that are traded in large quantities and in which price and cost competition dominates (as opposed to quality competition).

5.4. SECURING THE EFFECTIVENESS OF SUPPORT REMOVAL OR REFORM

As stated before, the effectiveness of support reform or removal also depends on the comprehensiveness of the reforms. Support removal will be most effective when combined with other market liberalisation policies and strong and targeted environmental policies. The simultaneous deregulation of all transport modes in the United States contributed to a greater increase in efficiency for all the modes than what has been experienced under the more piecemeal approach in Europe. For the market system to function properly, it is best that all prices are more or less “right” (*i.e.*, market-determined, including the costs or benefits of the relevant missing markets), since prices for different commodities and services tend to influence each other. Thus, the price of a supported commodity or service will influence various up- and downstream prices, spreading its incorrect signal to many different products.

Support reform or removal will only take place if it is politically acceptable. In addition to ensuring the full benefits and costs of removing support measures, including their environmental effects, are brought to the attention of policy makers for evaluation, it is also important to involve the relevant stakeholders. Because of the lack of available information on support mechanisms, and their highly political nature, those who benefit and those who pay for them are often either unaware of their costs and benefits or have inaccurate conceptions of them. Increasing transparency and involving stakeholders in the decision-making process can lead to more effective and democratic decisions.

Finally, to ensure the ongoing relevance of existing support policies and the reform or removal of others, an internationally agreed upon monitoring process should be established. The thorough monitoring of support removal is essential both for multilaterally agreed programmes and for national purposes to ensure the effectiveness of the removal policies and to avoid undue hardships and side effects.

5.5. POLICY CONCLUSIONS REGARDING IMPLEMENTATION ISSUES

Despite concerns that most support removal can only result in a net benefit to the implementing country if other countries simultaneously remove their supports, such a prisoners’ dilemma scenario is generally rare with respect to internationally-traded commodities. As shown above, unilateral support removal is often the socially optimal strategy, regardless of the behaviour of other countries. This can also be seen through the successful results of a number of unilateral actions, such as the reduction of agricultural support in New Zealand. While the short-term

results in the country included a significant decrease in agricultural products as a share of total exports, in recent years the agricultural sector has become more competitive and efficient and New Zealand is now one of the few industrial countries where the number of farmers is currently rising.

In addition, other developments, either within the country or in the market for the commodity, can lead to significantly divergent outcomes as a result of support removal compared with what a standard analysis of the situation might indicate. Thus, for example, the dramatic reduction of coal support in the United Kingdom in the 1980s did not lead to an increase in imported coal as might have been expected. Instead, because the reduction of support was accompanied by a general liberalisation of the energy markets, there was a significant shift to the use of nationally-produced natural gas. However, for political reasons, it is often the *perceived* welfare losses that leads countries to maintain supports, not the *actual* welfare losses that could be expected. In such cases, internationally co-ordinated actions may not always turn all countries into (perceived) winners either. Again, an important strategy for tackling such a problem is increasing the transparency of the support measures, including identifying those who benefit from the measure and those who pay for it, and by how much. A feasible solution may require the implementation of compensating measures to those who would lose from the support removal.

There is little conclusive evidence on the effect that unilateral support reduction has on the competitiveness of a sector, let alone on the overall economy. In order to determine such effects, it would be necessary to disentangle the impact of the support removal on the sector from what would have happened in the sector had the support been maintained. Of course, the support removal will take place concurrently with other exogenous changes and developments, making this disentangling process extremely difficult. Even more complex would be an examination of the full economy-wide effects of support removal, necessitating not only an understanding of the effects on the previously supported industry, but also how these effects will then impact on competing and complementary industries, as well as an examination of how the finances previously used to fund the support will be recycled in the economy and what effects this may have. As a result, where attempts have been made to analyse the costs and benefits of support removal, they are often limited solely to the effects of support removal on the immediate industry (*i.e.*, the “costs” of support removal), thus potentially biasing the results against support removal.

For a number of support measures, true prisoners’ dilemma situations do exist, or the perception that they exist is extremely strong. In such cases, the implementation of internationally agreed upon strategies can lead to more acceptable outcomes. For example, in a number of cases – such as the removal of preferential low rates of taxation on widely-used commodities or energy – interna-

tional co-operation can ease the support removal process and may even be a pre-requisite for comprehensive reforms. Even where prisoners' dilemma situations do not exist, international co-operation to agree support removal can increase the political acceptability of the programmes.

It is important that any support reduction is accomplished as part of a package of general trade liberalisation policies, accompanied by regulatory reform and other measures. Without such a comprehensive approach, other policy measures may serve to counteract the effects of support reform or removal. In addition, it may be necessary to implement temporary transitional policies to ease the effects of support removal on the previously supported industry and workers, such as through the replacement of support based on production or input levels with decoupled direct income support.

Increasing the transparency of existing support measures is perhaps one of the most important steps towards identifying and calculating total existing support and then estimating the full benefits that could be realised through support removal. It is largely because of the current opacity of support – a result of both the large number and range of support measures in existence and disagreements on the definition of “support” – that relatively small, but powerful, pressure groups are able to successfully lobby for the continuance of support measures which are a net drain on the economy. Increased support transparency will also simplify international negotiations on trade liberalisation.

6. MAIN FINDINGS

Based on the reviewed literature and case studies, and the analytical framework developed in this report, the main findings of this report are the following:

1. A subsidy can be defined as “environmentally-harmful” if it encourages more environmental damage to take place than what would occur without the subsidy. What qualifies as an environmentally-harmful subsidy will vary over time and place. Where there are clearly defined national or common environmental goals, such as the reduction of greenhouse gases, environmentally-harmful subsidies will be more readily identifiable.
2. The majority of support in OECD Member countries is conditional either on input use or output levels. The largest quantities of support are implemented through market price support, which increases the marginal revenues of the recipient sector at the expense of consumers and taxpayers.
3. Although the rather limited available data suggests that a decline in overall support assistance is taking place, in most cases this decrease is taking place very slowly.
4. The levels and trends in support within individual Member countries, sectors and products are very uneven, with some even showing increasing levels of support.
5. Available data indicate a modest shift from support conditional on inputs and products to direct income support, the latter often being in compensation for reductions in market price support. Although this will often reduce the negative environmental effects of the support, these benefits will be reduced if the link between the payments and environmentally-harmful practices is not fully severed.
6. Support in OECD Member countries is mainly given to inefficient firms in mature industries (including agriculture) in order to protect these industries from foreign competition. But ongoing technical changes and market developments add to the competition faced by these industries. If a

supported industry does not adapt to these changes, it may be put at an even greater competitive disadvantage, thus necessitating higher levels of support to maintain its ongoing viability. Therefore, the maintenance of a given level of protection may require increasing levels of funding.

7. It is the combined effect of the support measure that is used and the taxation regime within which it is applied that will determine the economic and environmental effects of the support. Thus, if the same support measure is applied under different taxation regimes, the effects of the support will differ.
8. Support measures consist of combinations of direct financial support mechanisms and the regulations which accompany them and that reinforce their effects. Their effectiveness in reducing competition depends on the combination as a whole, including their effects on upstream and downstream economic activities as well. Removing only one element from a combination of support measures and regulations will often have only a limited impact, and can sometimes actually increase inter-sectoral distortions.
9. The mechanisms which link support levels and environmental degradation are complex. Thus, the effects of a given support measure on the environment will be mediated by three intervening linkages: the impact of the support on the volume and composition of output in the economy, the mitigating environmental policies in place, and the assimilative capacity of the affected environment. As a result, the level of support to a particular industry will not necessarily reflect the level of environmental damage that will occur as a result of the support.
10. Support can have weak beneficial effects on incomes, growth and employment in the intended recipient sector, while having strong adverse effects on the environment.
11. Although it is difficult to calculate the exact environmental effects of support policies, a quick scan of the support type and the characteristics of the recipient sectors can often indicate the potential environmental effects of support reform or removal through an examination of:
 - the point of impact of the support measure, and its relative share in (marginal) costs or revenues;
 - the direct and indirect links between the point of impact of the support and the large and polluting substance flows through the economy; and
 - the elasticities of demand and supply on both the input and output markets – these determine the magnitude of volume responses to

price changes and the proportion of the support that leaks away to sectors other than the targeted sector.

By examining these characteristics, a quick scan of support measures to be prioritised for reform or removal can be made.

12. The positive environmental effects of support removal will often become apparent only after a relatively long time span. This will particularly be the case where past support has encouraged investment in long-lasting infrastructure, thus locking-in the use of certain inputs or processes for years to come. Any estimates of the environmental benefits of support removal will necessarily depend both on the assumptions made regarding the potential technical developments that will occur in the future and the time horizon examined.
13. Support removal, in particular with respect to support which is coupled to input or production processes, will encourage a broader scope of technical developments than if the support is continued. As a result, it is likely that the total environmental benefits of support removal will be larger than estimates based on empirical evidence can predict, both because of the increasing benefits that accrue over longer time periods and because of the greater range of technological developments made possible by the support removal. As a result, no matter how thorough they are, analyses of support removal will always be open to question.
14. Support removal can cause hardships, but most of these can be mitigated through the use of careful implementation strategies, including the possibility of compensating those who might suffer as a result of the support removal.

7. POLICY CONCLUSIONS

As per the mandate given by the OECD Council at Ministerial Level, the conclusions listed below refer to all support measures that are “environmentally-harmful” and, therefore, do not apply to those that effectively improve environmental quality. The conclusions also reflect that, in some circumstances, detailed local-level analysis will be necessary to determine the exact environmental effects of support removal or reform.

7.1. GENERAL CONCLUSIONS

Getting the prices right

Market prices do not always reflect the true costs and benefits to society of economic activities. This often aggravates environmental pressures. In order to ensure that prices do reflect social costs, it would be necessary to both remove any support measures in place which artificially lower the private costs of the activities and to better internalise negative external effects through appropriate regulations or economic instruments.

When an environmentally-malign activity is supported, a policy to create a price differential in favour of less environmentally-damaging alternatives through supporting the environmentally-benign activities is only a second best policy. A preferable approach would be to remove any existing support from the environmentally-malign activities and to better internalise external costs they may generate.

Increasing the transparency of support

Support is often introduced to serve the interests of specific sectors or regions in the economy. The full effects of the support are, however, generally more widespread, less understood, and often only partially analysed. Many sectors and groups in the economy may be affected besides the intended recipient sector, sometimes positively, but more often negatively. It is essential that the transparency of support measures be increased in order that these trade-offs between sectoral and general interests in society can be clarified.

Prioritising support measures to be eliminated or reformed

The removal or reform of support measures that are linked to production or input levels should be a high priority. Such measures encourage both the emission of unnecessary levels of pollution and waste and the squandering of natural resources, and so may counteract policies directed at increased resource productivity. The removal or reduction of such support will

- decrease government spending, reduce pollution levels and the costs of applying environmental policies, and increase the overall efficiency of the economy, thus leading to higher government revenues in the long run; and
- stimulate technological change in directions that are crucial for future environmental quality, notably through increasing resource productivity and curbing pollution from non-point sources. If support is conditional on a particular process or product, the supported process or product will be “locked-in” and the development of potential environmentally-beneficial technological innovations will be limited to simply improving on these products or processes.

In prioritising support measures for reform or removal, a comprehensive approach is preferred and, where possible, should include an examination of all the relevant markets which are affected by the support. The final analysis should be based on the net, overall effects of support reform or removal.

Countries may wish, in particular, to prioritise for reform or removal those support measures that have immediate budgetary consequences.

Alleviating possible hardships of support removal

Reducing support causes financial gains and losses, which will often be unevenly spread. It may be desirable to devise policy packages to alleviate the possible hardships associated with support removal, using measures that do not link the transfers to particular practices or the use of particular inputs or factors of production (*i.e.*, capital or land).

A well directed environmental policy is also required

Releasing market forces through support reform or removal and increasing the effectiveness and efficiency of regulations (regulatory reform) will stimulate technological change – which is vital for achieving environmental objectives. In particular, technological changes that increase resource productivity are amongst the most promising for achieving environmental objectives. Technological change may, however, also have adverse effects on the environment. In order to reap the maximum benefits from support reduction, an effective and well-directed envi-

ronmental policy will also be required to guide developments and changes in the most beneficial directions.

Unilateral support removal

Often a thorough identification of all the beneficiaries and losers of a support policy is required to adequately understand the full costs and benefits of support removal. In many cases (particularly when support is given to ailing industries), successful and profitable support reduction does not require an internationally agreed upon policy between many countries. There are various examples of unilateral support reductions which have resulted in net benefits to the economy as a whole and, occasionally, without loss of competitiveness of the sector involved. OECD Member countries should identify such possibilities and implement unilateral support reductions where net benefits can be realised.

7.2. FURTHER OECD WORK

Shared goals

Where OECD Member countries have, or develop, common environmental goals or principles – in particular those under global or regional environmental conventions, such as, for example, the Kyoto Protocol to the UN Framework Convention on Climate Change, the UN Framework Convention on Biological Diversity or the UNECE Convention on Long-Range Transboundary Air Pollution – the removal of support measures which encourage the environmental damage can contribute towards the attainment of these goals and the polluter pays principle. As such, support removal can be seen as one of a number of policy tools for realising environmental objectives.

Removing obstacles

It is often the *fear* that a country will incur a net loss through support removal that prevents such actions, even when they would prove beneficial overall. A primary obstacle to overcoming such misperceptions is the lack of available data or a clear understanding of the benefits and losses of support removal. Increasing transparency and gathering the relevant data can help to remove this obstacle. In addition, even in situations where countries can realise net benefits through unilateral support reduction, negotiating co-operated multilateral reductions can increase the political acceptability of the policies.

Data collection and monitoring progress

International co-operation, as well as any unilateral actions, requires reliable and comparable information on support levels in Member and non-Member countries. In light of the limitations of the current data on support for most sectors and its effects on the environment, the OECD should prioritise the collection of such information.

Monitoring the existence of support measures and their removal – particularly with respect to support relating to agriculture, energy and materials – is essential for increased transparency, political viability and co-operative support removal. Where data is incomplete or unavailable, the OECD should develop appropriate measures of support levels, such as the producer and consumer subsidy equivalents, and publish the relevant data and trends in new or existing periodical reviews.

It is important that data is collected on support measures and their environmental effects which relate, in particular, to the shared goals of OECD Member countries.

International co-operation

International co-operation in reducing support levels can facilitate the process of support removal and limit any potentially negative side effects that may exist. In particular, negotiating multilateral reductions of support which is common in most countries can lead to increased environmental benefits and reductions in government expenditures, with little or no loss of competitive advantage in the affected sectors. The OECD should identify true prisoners' dilemmas and suggest appropriate multilateral strategies for support removal where required.

NOTES

1. Particularly seminal studies were carried out by Kosmo (1987) and Burgess (1990). Kosmo analysed energy support, notably to oil and electricity in a number of countries, and treated their environmental effects in a qualitative way. Burgess used the Kosmo estimates of support to electricity to calculate reductions of carbon emissions of their elimination.
2. Normal rates can be defined in several, more or less, similar ways. One definition might be “the rates that would apply in the absence of any exception to the advantage of individuals or juristic persons for their private activities”. It is the “exceptions” in this description that are included in the definition of “support”.
3. In the case of support to energy, for example, the motive of supply security is often cited as well. This can be regarded as an element of the economic growth motive.
4. The difference between the potential and actual environmental effects is determined by the amount of emissions that will be reduced by existing environmental policies and the assimilative capacity of the receiving environment. See linkages 2 and 3 as discussed in Section 3.1.
5. Agricultural producer support constitutes 56 per cent of total agricultural transfers.
6. The producer subsidy equivalent, PSE, is an indicator of the value of the monetary transfers to (agricultural) producers resulting from (agricultural) policies in a given year. It includes both transfers from consumers of agricultural products (through domestic market price support) and transfers from taxpayers (through budgetary or tax expenditures). The consumer subsidy equivalent, CSE, measures the value of monetary transfers to (or from) consumers resulting from (agricultural) policies in a given year. Typically it includes both a negative component measuring the implicit tax imposed on consumers by market price support measures and a positive component representing transfers from government funds to support consumers.
7. PSEs and CSEs are calculated for a standard set of 13 commodities. The share of the value of agricultural production covered varies widely from country to country. Mainly due to incomplete information, coverage of some policies is uneven particularly with respect to taxation concessions, sub-national and agri-environmental measures. Caution should therefore be exercised in the interpretation of PSEs and CSEs and of the indicators derived from them and in making cross-country comparisons. Discussions are

on-going on the nature and interpretation of PSEs, including the coverage and classification of measures in the calculations of PSE and total transfers.

8. These calculations do not include France, nor any transfers relating to past production, such as the responsibility for pollution from abandoned coal mines or support to families of black lung disease sufferers.
9. Preliminary results from the OECD's eco-tax project confirm these trends, with hardly any taxes found to be paid on coal in the countries examined.
10. According to economic theory, the price of a marginal unit of transportation activity should ideally equal the marginal social costs (i.e., the private costs plus the externalised social and environmental costs). However, because the marginal social costs are extremely difficult to determine for transportation activities, and because there are a limited range of economic tools available for applying marginal cost pricing to these activities, such an exercise is largely impractical. As a second best alternative, a number of governments use average or total cost pricing rules instead – such as through a comparison of the total annual revenues and expenditures of a transport activity.
11. The European Conference of Ministers of Transport (ECMT) has recently engaged in a study to construct comprehensive measures of distortionary support to transport.
12. The ECMT countries are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, and the United Kingdom.
13. This is somewhat unusual as it is generally revenues from urban road users that are found to cross-subsidise rural road users.
14. Because of the difficulties mentioned in the text above, the results from the first phase of the project are not very reliable.
15. The Net Cost to Government (NCG) calculates the difference between the cost of funding a programme in any given year and the revenue generated for the public budget by the same programme in that year.
16. Similarly, a shallow demand curve – a large price elasticity of demand – reflects a large volume response to a given change in price.
17. This typology is from Ayres and Ayres (1996). Of course, one could choose other definitions and terminologies, but the conclusions regarding the relative cost-effectiveness of various resource productivity strategies as compared with end-of-pipe technologies remain the same.
18. Similar policies were already underway in France.
19. A similar problem is identified by Gardner (1997) with respect to subsidies to irrigation water. He finds that, because land is the asset that entitles farmers to the subsidised irrigation water, the long run land markets will capitalise the expected future subsidy value into land values. Thus, while the land owner at the time the subsidy is initiated will reap a windfall profit from it, subsequent land owners will pay a higher price for the land as a result and will not benefit from the subsidy. This raises a further problem because a reduction or removal of the subsidy will penalise the current land owner, who may not have benefited from the subsidy in the first place.

20. Two studies on energy subsidies in the United States, for example, differed in their estimates of total federal energy subsidies by a factor of two, and by a factor of six for their estimates of the effect of removing subsidies on carbon dioxide emissions.
21. The case studies are listed in Table 4.2.
22. Often support merely enables an industry to offer its products or services at the current market price. Without the support, the industry would not be competitive in the international arena and would collapse. The removal of a budgetary support to producers will lead to higher prices faced by the consumer only if the support allowed the domestic producer to sell the goods or services below the world market prices, or the support was significant enough that its removal would have an affect on the prevailing world market price.
23. Little is known about the potential cost reductions that can be realised from energy saving strategies, including material substitutions, which may prove energy demand is more elastic in the long run. It is likely that new substitution possibilities will develop over time, and existing ones become economically-feasible, if support measures are reduced.
24. Through environmental taxes or charges, for example.
25. The countries studied were France, Germany, Switzerland and the Netherlands.
26. It is likely that a more comprehensive analysis of inland and sea-bourne shipping would also have shown relatively low marginal effective tax rates for these freight transport modes.
27. For example, support to hard coal production in 1990 per miner employed was US\$84 400 in Belgium, US\$90 200 in Germany and US\$38 000 in the United Kingdom (Anderson and McKibbin, 1997).

REFERENCES

- ANDERSON, K. (1992), "Effects on the Environment and Welfare of Liberalising World Trade: the cases of Coal and Food", in Anderson, K. and Blackhurst, R. (eds), *The Greening of World Trade Issues*, University of Michigan Press, Ann Arbor and Harvester Wheatsheaf, London.
- ANDERSON, K. (1995), "The Political Economy of Coal Subsidies in Europe", in *Energy Policy*, Vol. 23, No. 6, pp. 485-496.
- ANDERSON, K. and MCKIBBIN, W.J. (1997), "Reducing Coal Subsidies and Trade Barriers: Their Contribution to Greenhouse Gas Abatement", Seminar Paper 97-07, Centre for International Economic Studies, University of Adelaide, Adelaide, Australia.
- ANDREWS, C.J. and GOVIL, S. (1995), "Becoming Proactive about Environmental Risks: Regulatory Reform and Risk Management in the US Electricity Sector", *Energy Policy*, Vol. 23, No. 10, pp. 885-892.
- AYRES, R.U. and AYRES, L.W. (1996), *Industrial Ecology: Towards Closing the Materials Cycle*, Edward Elgar, Cheltenham, UK.
- BURGESS, J.C. (1990), "The Contribution of Efficient Energy Pricing to Reducing Carbon Dioxide Emissions", *Energy Policy*, Vol. 18, No. 5, pp. 449-455.
- BURNIAUX, J-M., MARTIN, J. and OLIVEIRA-MARTINS, J. (1992), "The Effects of Existing Distortions in Energy Markets on the Cost of Policies to Reduce CO₂ Emissions: Evidence from GREEN", in *OECD Economic Studies*, Winter 1992, pp. 141-165.
- CENTRE FOR INTERNATIONAL ECONOMICS (1988), "Just What is a Trade Subsidy?", in *The Mining Review*, August, pp. 10-13.
- CHEN, D. (1998, forthcoming), "The Effects of Taxes and Support on Marginal Costs: Quantitative Illustrations", in OECD, *Improving the Environment through Reducing Subsidies, Part III: Case Studies*, OECD, Paris.
- DE MOOR, A.P.G. (1997), *Subsidies and Sustainable Development: Key Issues and Reform Strategies*, Earth Council, San Jose, Costa Rica.
- DFI (Decision Focus Incorporated) (1993), "Analyzing Energy Subsidies and Greenhouse Gas Emissions", Task 6 Memo for EPA Contract 68-WI-0009, Work Assignment # 131, DFI, Washington, DC.
- DJA (Dale Jorgensen Associates) (1994), "The Elimination of Federal Energy Subsidies: Environmental Gains, Tax Considerations and Economic Consequences", report of results and findings prepared for the OECD under contract to US EPA, Cambridge, MA.

- DRI (1997), "Effects of Phasing Out Coal Subsidies in OECD Countries", in OECD, *Reforming Energy and Transport Subsidies: Environmental and Economic Implications*, OECD, Paris, pp. 101-105.
- ECMT (1997), *Trends in the Transport Sector, 1970-1995*, OECD, Paris.
- ECMT (1998), *Efficient Transport for Europe: Policies for Internalisation of External Costs*, OECD, Paris.
- ECON CENTRE FOR ECONOMIC ANALYSIS (1996), "Energy Taxes: Trends and Structure in OECD and Selected Non-OECD Countries", Report No. 44/96, Commissioned by the Ministry of Industry and Energy, Norway.
- EUROSTAT (1996), *Statistics in Focus: Environment*, 2.
- GARDNER, D. (1997), "Some Implications of Federal Grazing, Timber, Irrigation, and Recreation Subsidies", in *Choices*, 3, pp. 9-14.
- GURVICH, E., GOLUB, A., UZYAKOV, M., MUKHIN, A. and KOROBOVA, N. (1997), "Greenhouse Gas Impacts of Russian Energy Subsidies", in Vol. I of "Environmental Implications of Energy and Transport Subsidies", OECD/GD(97)154, OECD, Paris.
- HALTMAIER, S. (1997), "Transport Subsidies: U.S. Case Study", in OECD, *Reforming Energy and Transport Subsidies: Environmental and Economic Implications*, OECD, Paris, pp. 153-165.
- HELMING, J. and BROUWER, F. (1998, forthcoming), "Environmental Effects of Changes in Taxation and Support to Agriculture", in OECD, *Improving the Environment through Reducing Subsidies, Part III: Case Studies*, OECD, Paris.
- IEA, *Energy Prices and Taxes*, OECD, Paris.
- IEA (1991), *Energy Policies of IEA Countries: 1990 Review*, OECD, Paris.
- IEA (1992), *Energy Policies of IEA Countries: 1992 Review*, OECD, Paris.
- IEA (1994), *Energy Policies of IEA Countries: 1993 Review*, OECD, Paris.
- IEA (1995), *The Role of IEA Governments in Energy, 1995 Update*, OECD/IEA, Paris.
- IEA (1996a), *Energy Policies of IEA Countries: 1996 Review*, OECD, Paris.
- IEA (1996b), *The Role of IEA Governments in Energy, 1996 Update*, OECD/IEA, Paris.
- IEA (1997), *Energy Policies of IEA Countries: 1997 Review*, OECD, Paris.
- KOPLow, D. (1996), "Energy Subsidies and the Environment", in OECD, *Subsidies and Environment: Exploring the Linkages*, OECD, Paris.
- KOSMO, M. (1987), *Money to Burn? The High Costs of Energy Subsidies*, World Resources Institute, Washington, DC.
- LARSEN, B. and SHAH, A. (1992) "World Fossil Fuel Subsidies and Global Carbon Emissions", Policy Research Working Paper Series, No. 1 002, World Bank, Washington, DC.
- MCKENZIE, K., MINTZ, J. and SCHARF, K. (1992), "Differential Taxation of Canadian and US Passenger Transportation", report of the Royal Commission on National Passenger Transportation, Vol. 4, Ottawa, Ontario.
- MICHAELIS, L. (1997), "Electricity-Related Supports in the United Kingdom", in OECD, *Reforming Energy and Transport Subsidies: Environmental and Economic Implications*, OECD Paris, pp. 129-136.

- MORISUGI, H. (1997), "The Social Costs of Motor Vehicle Use in Japan", in OECD, *Reforming Energy and Transport Subsidies: Environmental and Economic Implications*, OECD, Paris, pp. 145-152.
- NAUGHTEN, B., MELANIE, J. and DLUGOSZ, J. (1997) "Supports to the Energy Sector in Australia", in "Supports to the Coal Industry and the Electricity Sector", Vol. 2 of "Environmental Implications of Energy and Transport Subsidies", OECD/GD(97)155, OECD, Paris.
- NORMANN, G., FRITZ, P. and SPRINGFELT, P. (1998, forthcoming), "Effects of Government Subsidies on the Environment: the Case of Electricity and Paper Production from a Swedish Perspective", in OECD, *Improving the Environment through Reducing Subsidies, Part III: Case Studies*, OECD, Paris.
- OBERSTEINER, M., NILSSON, S. and WORGOTTER, A. (1998, forthcoming), "Environmental and Economic Effects of Support to the Austrian Pulp and Paper Industry", in OECD, *Improving the Environment through Reducing Subsidies, Part III: Case Studies*, OECD, Paris.
- OECD (1987), *Toll Financing and Public Sector Involvement in Road Infrastructure Development*, OECD, Paris.
- OECD (1992a), *Industrial Support Policies in OECD Countries, 1986-1989*, OECD, Paris.
- OECD (1992b), *Market and Government Failures in Environmental Management: The Case of Transport*, OECD, Paris.
- OECD (1994), *Agricultural Policies, Markets and Trade: Monitoring and Outlook 1994*, OECD, Paris.
- OECD (1995), *Adjustment in OECD Agriculture: Issues and Policy Responses*, OECD, Paris.
- OECD (1996a), *Subsidies and Environment: Exploring the Linkages*, OECD, Paris.
- OECD (1996b), *Public Support to Industry: Report by the Industry Committee to the Council at Ministerial Level*, OECD, Paris.
- OECD (1996c), *Implementation Strategies for Environmental Taxes*, OECD, Paris.
- OECD (1996d), *Agricultural Policies, Markets and Trade: Monitoring and Outlook 1996*, OECD, Paris.
- OECD (1997a), *Reforming Energy and Transport Subsidies: Environmental and Economic Implications*, OECD, Paris.
- OECD (1997b), *Environmental Taxes and Green Tax Reform*, OECD, Paris.
- OECD (1997c), *OECD Report on Regulatory Reform: Synthesis Report*, OECD, Paris.
- OECD (1997d), *Agricultural Policies in OECD Countries: Monitoring and Evaluation, 1997*, OECD, Paris.
- OECD (1997e), "Liberalisation and Structural Reform in the Freight Sector in Europe", OECD, Paris.
- OECD (1997f), "Liberalization in the Transport Sector in North America", OECD, Paris.
- OECD (1998), *The Environmental Effects of Reforming Agricultural Policies: A Preliminary Report*, OECD, Paris.
- OKKEN, P.A. and GIELEN, D.J. (1994), *Optimisation of Integrated Energy and Material Flows: Methodological Considerations and Model Calculations for the Netherlands Beyond 2000*, Netherlands Energy Research Foundation ECN, Petten.

- ORFEUIL, J.-P. (1997), "Evaluation of the External Costs of Road Transport in France and the Consequences of Cost Internalisation", in OECD, *Reforming Energy and Transport Subsidies: Environmental and Economic Implications*, OECD, Paris, pp. 137-144.
- PILLET, G. (1998, forthcoming), "Marginal Effective Tax Rates for Different Transport Models in Four European Countries", in OECD (1998 Forthcoming), *Improving the Environment through Reducing Subsidies, Part III: Case Studies*, OECD, Paris.
- RAINELLI, P. and VERMERSCH, D. (1998, forthcoming), "Environmental Impacts and Agricultural Support: Cereal Irrigation in France", in OECD, *Improving the Environment through Reducing Subsidies, Part III: Case Studies*, OECD, Paris.
- RUIJGROK, E. and OOSTERHUIS, F. (1997), *Energy Subsidies in Western Europe*, Greenpeace International, Amsterdam.
- SHELBY, M., SHAKLETON, R., SHEALY, M. and CRISTAFARO, A. (1997), "Climate Change Implications of Eliminating US Energy Subsidies", in OECD, *Reforming Energy and Transport Subsidies: Environmental and Economic Implications*, OECD, Paris, pp. 77-89.
- STEENBLIK, R.P. (1995), "A Note on the Concept of "Subsidy"", in *Energy Policy*, Vol. 23, No. 6, pp. 483-484.
- STEENBLIK, R.P. and COROYANNAKIS, P. (1995), "Reform of Coal Policies in Western Europe and Central Europe: Implications for the Environment", in *Energy Policy*, Vol. 23, No. 6, pp. 537-553.
- STERNER, T. (1996), "Tax Expenditures and the Environment", in OECD, *Subsidies and Environment: Exploring the Linkages*, OECD, Paris.
- TOSATO, G. (1997) "Environmental Implications of Supports to the Electricity Sector in Italy", in OECD, *Reforming Energy and Transport Subsidies: Environmental and Economic Implications*, OECD, Paris, pp. 115-123.
- VERBRUGGEN, H. and OOSTERHUIS, F. (1998, forthcoming), "Competitiveness and Reduction of Support Measures to Industry: The Prisoners' Dilemma", OECD, *Improving the Environment through Reducing Subsidies, Part III: Case Studies*, OECD, Paris.
- VETLESEN, J. and JENSEN, E. (1997), "The Market Reforms in the Norwegian Electricity Sector", in "Supports to the Coal Industry and the Electricity Sector", Vol. 2 of "Environmental Implications of Energy and Transport Subsidies ", OECD/GD(97)155, OECD, Paris.
- VOLLEBERGH, H. (1998, forthcoming), "Energy Support Measures and Their Environment Effects: Decisive Parameters for Subsidy Removal", in OECD, *Improving the Environment through Reducing Subsidies, Part III: Case Studies*, OECD, Paris.
- WOLFSON, D.J. (1990), "Towards a Theory of Subsidization", in GERRITSE, R. (ed.), *Producer Subsidies*, Pinter Publishers, London and New York.
- WORLD BANK (1992), *The World Development Report, 1992*, Oxford University Press, Oxford.

Annex 1

THE MANDATE

The OECD Environment Ministers at their meeting of 20 February 1996 urged the OECD to consider, mindful of budgetary constraints, strengthening its efforts in key areas by undertaking *inter alia*:

a wide-ranging study of the effects of subsidies and tax disincentives to sound environmental practices in various economic sectors and the costs and benefits of their elimination or reform, as proposed by the G-7 Environment Ministers in May 1995. The study should be presented to the OECD council within two years.

The council at Ministerial level at its meeting of 21 and 22 May 1996 requested the OECD to (*inter alia*)

undertake further examination of the potential for environmental (or “green”) tax reform and analysis of the elimination or reform of environmentally-harmful subsidies, with a view to presenting reports to Ministers in 1997 and 1998 respectively.

The organisation was requested to concentrate on this work as a core priority, with the intention that it would facilitate the implementation of Ministers' commitments, bearing in mind the requirement to fit new work within a constrained budget.

In 1996 an *Ad hoc* Group of Experts on Subsidies and the Environment, representing both environment and fiscal delegates, was formed to oversee the project. Five meetings were held to monitor the progress of the report. Both the Environment Policy Committee (EPOC) and the Committee on Fiscal Affairs (CFA) were kept informed of the progress of the report.

Annex 2

THE ROLE OF PRICE ELASTICITIES OF DEMAND AND SUPPLY IN DETERMINING THE EFFECTS OF DIFFERENT SUPPORT MEASURES

1. THE “SUPPORT SHIFTING FACTOR”

Case 1. Producers are supported: Effects on the output market of support that lowers the cost of production. For example: Lower excise duties on fuels for energy intensive industries.

Let U^I be the support to the producer per unit of product conditional upon an input (in the input market, I), *i.e.*, the amount by which the costs of producing the product decrease due to the support measure. Let ΔP^O be the amount by which the market price of the product (on the output market, O) is decreased as a result of the support, and β^O be the portion of the support that ends up with the buyers of the product instead of the producers (*i.e.*, what is “leaked” away from the producers to the consumers through reduced prices of the product). Then,

$$\Delta P^O = \beta^O * U^I, (0 < \beta^O < 1)$$

Let η^{do} and η^{so} be the absolute values of the demand and supply elasticities respectively on this output market, and ΔQ^O the change in sales volumes as a result of the support, then the demand and supply elasticity on the output market are given by

$$\eta^{do} = \frac{\frac{\Delta Q^O}{Q^O}}{\frac{\Delta P^O}{P^O}} = \frac{\Delta Q^O}{\Delta P^O} * \frac{P^O}{Q^O} \text{ and } \eta^{so} = \frac{\Delta Q^O}{U^I - \Delta P^O} * \frac{P^O}{Q^O}$$

Then β^O in terms of η^{do} and η^{so} becomes

$$\beta^O = \frac{\eta^{so}}{\eta^{so} + \eta^{do}}, (0 < \beta^O < 1)$$

Case 2. Buyers are supported: Support that reduces the selling price of a product. For example: low VAT rates for electricity

In this case, the support is given to the output market (U^o) with some of the support leaking to the producers of the product on the input market from the buyers, as given by β^I . The relevant formulas are then given by:

$$\Delta P^I = \beta^I * U^o, (0 < \beta^I < 1)$$

$$\eta^{di} = \frac{\Delta Q^I}{U^I - \Delta P^I} * \frac{P^I}{Q^I}, \text{ and } \eta^{si} = \frac{\Delta Q^I}{\Delta P^I} * \frac{P^I}{Q^I}$$

$$\beta^I = \frac{\eta^{di}}{\eta^{si} + \eta^{di}}, (0 < \beta^I < 1)$$

2. VOLUME EFFECTS

Case 1. Producers are supported: Effects on the output market of support that lowers the cost of production.

Let ΔQ^o be the change in the volume of sales that results from the input-based support U^I . Then γ^o can be defined as the relative volume changes due to the relative price changes caused by a support measure such that

$$\gamma^o = \frac{\frac{\Delta Q^o}{Q^o}}{\frac{U}{P^o}} = \frac{\Delta Q^o}{U} * \frac{P^o}{Q^o}$$

Expressing γ^o in terms of the price elasticities of demand and supply, yields

$$\gamma^o = \eta^{do} * \beta^o$$

Case 2. Buyers are supported: Support that reduces the selling price of a product.

In this case the formulas become

$$\gamma^I = \frac{\Delta Q^I}{U^I} * \frac{P^I}{Q^I} \text{ and}$$

$$\gamma^I = \eta^{si} * \beta^I$$

3. GRAPHICAL PRESENTATION

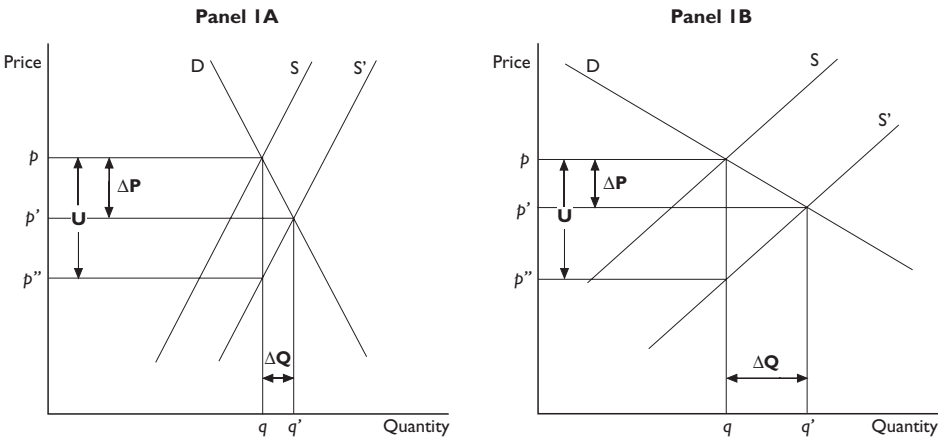
Case 1. Producers are supported: The supply curve shifts downwards

In panels 1A and 1B of Figure 1, S denotes the supply curve, S' the supply curve shifted downwards due to the support given, D denotes the demand curve, p the initial market price, p' the new market price due to the support and p'' the new cost of production. ΔP represents the change in the price of the product as a result of the support, thus representing how much of the support “leaks” away from the producers to the consumers of the products.

In panel 1A, both the demand and supply elasticities are “moderate”, moreover, they are approximately equal (the slopes of the demand and supply curves are equal). This leads to a support shifting factor of approximately 0.5, and a moderate volume effect. Panel 1B, by contrast, shows a more elastic demand in response to price than supply (shallower demand curve than supply), leading to a smaller support shift (leakage of the support), but a larger volume effect.

The steeper the demand curve (the smaller the price elasticity of demand) and at the same time the shallower the supply curve (the larger the price elasticity of supply), the larger the support leakage effect will be. In such cases, the environmental effects will be relatively small. However, if both the demand or

◆ Figure 1. *Producers are supported through lower costs of production*



Source: OECD.

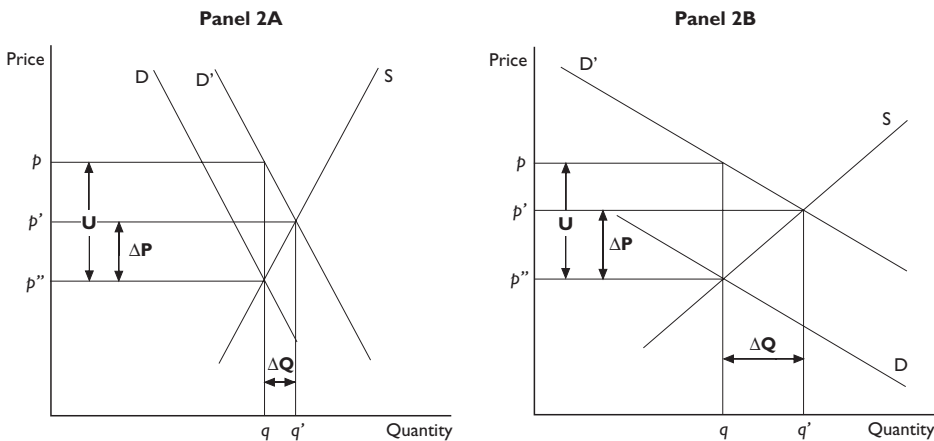
supply curve are shallow instead as in panel 1B then the transfer efficiency of the support will be better, but the pollution effects will be larger.

Case 2. Buyers are supported: The demand curve is shifted upwards

In panels 2A and B of Figure 2, the demand curve is D and the supply curve S again. The support U moves the demand curve upwards, to D' . This increased demand then pushes the market price up (ΔP), resulting in a leakage of the support away from the buyer and to the producer.

In panel 2A, demand and supply elasticities are again approximately equal, which results in a leakage of the support of about 50%. Both elasticities are moderate, yielding a moderate volume, or pollution, effect. In panel 2B, the demand elasticity is larger than the supply elasticity, giving rise to a larger leakage effect. In addition, because the demand curve is shallower than in panel 1A (i.e., the price elasticity of demand is more elastic) there is also a larger volume or pollution effect. Thus, the more price elastic the demand curve is compared with the supply curve when the buyer is supported, the larger both the leakage effects and the environmental effects of the support will be.

◆ Figure 2. **Buyers are supported through reduced prices for products purchased**



Source: OECD.

The role of price elasticities of demand and supply: a graphical overview

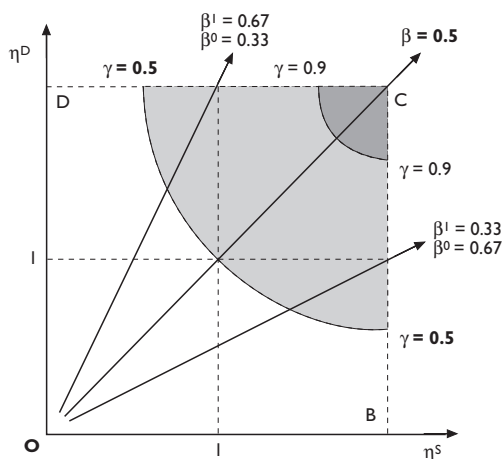
In Figure 3, the leakage and volume effects are depicted as the results of various values of the price elasticities of demand and supply.

On the vertical axis we have η^d , on the horizontal axis, η^s . If they are equal, $\beta^o = \beta^l = 0.5$, which is depicted by the straight line from the origin of OC. In the triangle OBC, $\beta^o > 0.5$ and consequently, $\beta^l < 0.5$. In this area, a support meant to favour a producer is moderately to highly *ineffective*. If the objective is to support the buyers of the product instead, the support is moderately to highly effective. The opposite holds true for the triangle ODC.

The volume effects (γ) are larger the further one moves away from the origin (O). The value of γ will be 0.5, if both elasticities are unity. At point C, $\gamma = 1$, meaning that the percentage volume effects of the support exceed even the percentage support.

Obviously, a support to favour a producer that operates on an output market characterised by a price elasticity of demand that is smaller than the price elasticity of supply (triangle OBC), but is still relatively large, giving rise to say,

◆ Figure 3. *Subsidy shifting factors for different combinations of demand and supply elasticities*



Source: OECD.

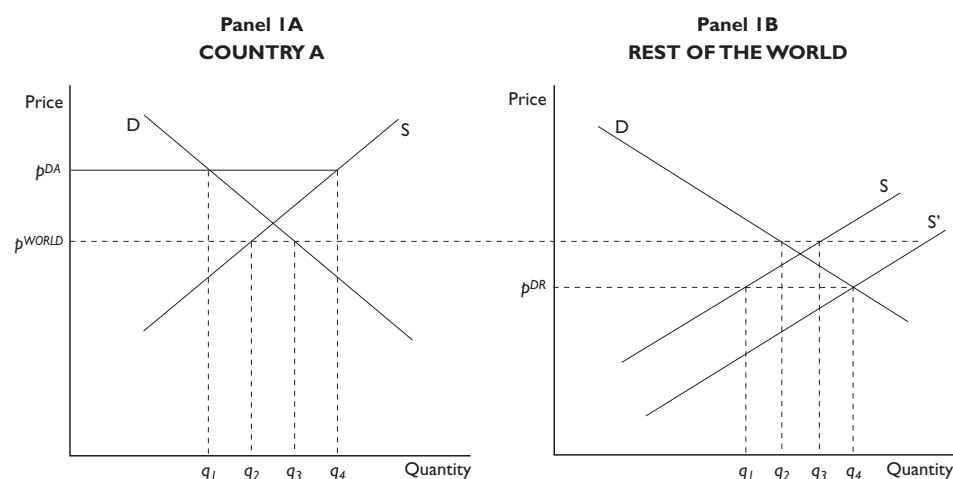
$\gamma > 0.5$, is inefficient in its support objective while also having large volume effects. Similarly, a support that falls in the shaded area of triangle ODC will not be effective in helping the buyers of the product, but will potentially still damage the environment significantly.

Annex 3

THE EFFECTS OF SUPPORT AND TRADE: A GRAPHICAL PRESENTATION

1. PRICE SUPPORT

◆ Figure 1. *Effects of a price support on supply and demand in the supporting country and the rest of the world*



Source: OECD.

Panels 1A and 1B contain supply and demand curves for country A and the rest of the world respectively. D represents the demand curves for the supported product in the respective markets, S the supply curves and S' the new supply curve after the support is applied. p^{WORLD} would be the world market price in the absence of any trade distortions, applying to country A and the rest of the world alike. Country A would produce quantity q_2 and demand quantity q_3 at this price, leading to imports from the rest of the world of $(q_3 - q_2)$.

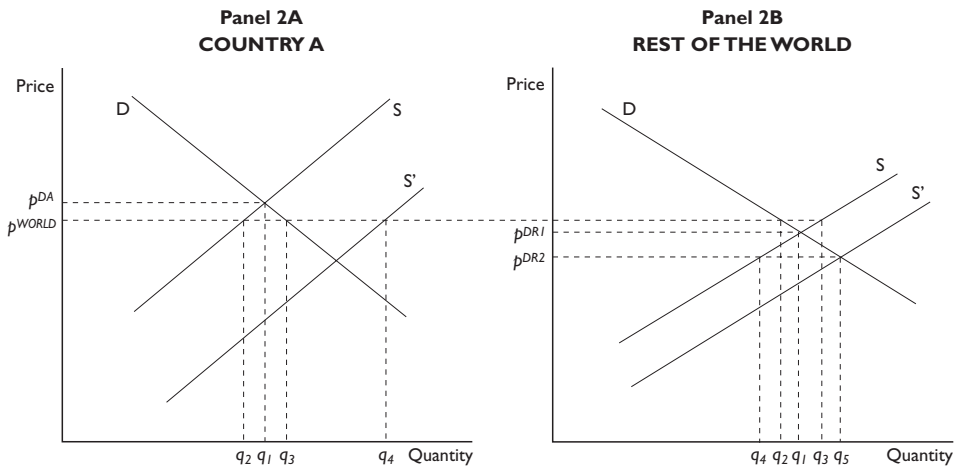
Now assume that country A introduces a minimum price of p^{DA} . At that price, a quantity of q_4 is produced and a quantity q_1 is demanded in country A, leading

to a surplus of $(q_4 - q_1)$. To prevent domestic sales reducing to the equilibrium of q_1 , the government of country A may intervene to ensure q_4 can be sold – for example, through government-brokered minimum domestic purchase agreements or supporting the export of the excess for sale in other countries at their (lower) domestic prices of p^{World} . If the former occurs, consumers will pay $(p^{\text{DA}} - p^{\text{World}}) * q_4$ extra in support and the previously imported $(q_3 - q_2)$ will no longer be required. If governments instead take responsibility for the sale of the excess quantity on the world market, the consumers in country A will support the producers by paying $(p^{\text{DA}} - p^{\text{World}}) * q_1$ more than would have been the case in the absence of the minimum price regulation, and government will support producers with an amount equal to $(p^{\text{DA}} - p^{\text{World}}) * (q_4 - q_1)$. Needless to say, both the support by consumers and by government will become more expensive if world market prices fall.

With a minimum price regulation in country A and an export of the excess to the world market, the rest of the world will now *import* $(q_4 - q_1)$, instead of *exporting* $(q_3 - q_2)$. This brings domestic prices in the rest of the world down to p^{DR} , benefiting its consumers but penalising its producers. Of course, this will also lower the price at which the government of country A can sell the excess products on the foreign markets, resulting in an even larger cost of this subsidy to the government.

2. SUPPORT THAT REDUCES THE COSTS OF SUPPLYING A PRODUCT, E.G., SUPPORT TO AN INPUT

◆ Figure 2. *Effects of support that reduces the costs of supplying a product on supply and demand in the country and the rest of the world*



Source: OECD.

Again, panels 2A and 2B contain supply and demand curves for country A and the rest of the world respectively. p^{World} would be the world market price in the absence of any trade distortions, applying to country A and the rest of the world alike. At this price, country A would produce quantity q_2 and demand quantity q_3 , leading to imports from the rest of the world of $(q_3 - q_2)$.

Now assume that country A introduces a support that lowers its domestic supply cost, leading to a shift to the right of the supply curve of country A to S' (panel 2A). Now quantity q_4 will be produced and q_3 demanded, leading to the export of quantity $(q_4 - q_3)$ (panel 2A). This export to the rest of the world will shift the supply curve of the rest of the world to the right to S' , with $(q_5 - q_4)$ the amount imported now from country A, compared with the previous $(q_3 - q_2)$ exported to country A (panel 2B). These imports will force down the initial domestic price in the rest of the world from p^{DR1} (before the introduction of the support in country A), to p^{DR2} . World prices will decrease as a result, the more so the larger the share of country A's exports in total world trade in the product. The final equilibrium world price for the good will depend on the intersection of the aggregated supply and demand curves of all countries together, after the introduction of the support measure in country A.

OECD PUBLICATIONS, 2, rue André-Pascal, 75775 PARIS CEDEX 16
PRINTED IN FRANCE
(97 98 09 1 P) ISBN 92-64-16091-4 – No. 50175 1998