ENVIRONMENTALLY HARMFUL SUBSIDIES

(Contribution to the ERE 2003 yearbook)

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INTRODUCTION

Every year, OECD Countries give about USD 400 billion in subsidies to different economic sectors. The objectives of Governments subsidies to various economic activities are often presented as to promote economic growth, employment and incomes. Subsidies distort prices, affect resource allocation decisions and change the amount of goods or services produced and consumed in an economy. Policies providing subsidies are generally introduced for various social or economic reasons, but they can have unintended negative effects on the environment that are generally ignored. Subsidies can thus result in a policy failure (see below) and be harmful to the environment. In agriculture, for example, they can lead to the overuse of pesticides and fertilisers and in fisheries to the overexploitation of the fish stock. Fuel tax rebates, subsidies for road transport, and low energy prices generally stimulate the consumption of fossil fuels and greenhouse gas emissions and increase congestion and air pollution.

Over the past twenty years, the OECD has made significant progress in the measurement and analysis of subsidies for sectors such as agriculture, coal production and fisheries. Factors contributing to the relatively modest progress in measuring support for other sectors range from complex methodological and data issues to a lack of political will to provide reliable and internationally comparable subsidy figures in some areas like manufacturing. Trade-offs are made both at national and international levels as data collection is often resource intensive and aggregate subsidy estimates are only as good as the underlying data. Although methodological and data constraints severely limit comparisons across sectors, work carried out by the OECD highlights agriculture as the sector with the largest subsidies (see below). While the other sectors seem pale in comparison, it is likely that subsidies are underestimated in these sectors due to the methodologies applied (Steenblik, 2003).

It should be noted that not all support measures implemented in environmentally sensitive sectors are potentially harmful. A number of support measures are specifically designed for environmental protection, such as support for pollution control investments (grants, soft loans, accelerated depreciation) and the development of "clean technologies" or energy efficiency. Support to production inputs can be targeted on non-polluting inputs or recycled materials; pricing of transport infrastructures may be designed to facilitate public transports etc. Whilst such support measures may be environmentally beneficial in the short/medium term, they may introduce rigidities, (e.g. vested interest) and distort markets in the longer

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term. Furthermore, they can contradict the Polluter-pays Principle, as defined by the OECD (1972). These environmentally motivated subsidies are not analysed in this paper.

This paper aims to identify environmentally harmful subsidies. After a brief reminder of the consequences of market and government intervention failures, it reviews the definition and measurement of different types of support measures. It then gives a brief overview of the magnitude of subsidies in OECD countries and analyses the environmental effects of these subsidies, taking into account the inter-linkages between the economy and the environment. It concludes with some considerations of the political, social and technical challenges associated with the phasing out of these subsidies. It does not claim to fully cover, nor to give a final answer to this very complex issue, but aims at providing a brief survey of the state of knowledge and main issues to be resolved. The issue of environmentally harmful subsidies will remain for a long time on the environmental, economic and political agendas.

1. WHY DO SUBSIDIES MATTER FOR THE ENVIRONMENT?

It is now widely recognised that environmental policies should rely, to the greatest extent possible, on properly functioning markets (i.e. with internalised externalities and no distorting subsidies and tax provisions). The need for an effective internalisation of externalities, which economists have been promoting for several decades, is now increasingly recognised by policy makers. Although the "Polluter-pays Principle" was promulgated thirty years ago by the OECD (1972), the implementation of an economic discipline and rationale in environmental policy is fairly recent and far from fully achieved. In particular, although the use of economic instruments in environmental policy, such as charges, taxes, tradable permits and deposit refund systems, has evolved considerably over the last fifteen years in OECD countries [OECD 1999, 2001a], Governments continue to perpetrate innumerable "intervention or policy failures"[2] generally in the form of inefficient regulations, subsidies and tax exemptions.

Take for instance the case of taxes; most OECD countries have undertaken significant tax reforms during the 1990s, chiefly in two ways: first by reducing tax rates in the higher income tax brackets (which fell on average by ten points between 1986 and 1997) and lowering corporate tax rates (down by 10 points over the same period); secondly, by broadening the tax base, especially for indirect taxes (VAT and consumption taxes). In this context, the "greening" of tax systems provides a good opportunity to correct market failures. However, energy related taxes are flawed by a host of exemptions, to the effect that 80% to 90 % of the burden of these taxes falls on households, thus virtually exempting the industry sector. Introducing new CO2 taxes, for instance, makes little economic sense if exemptions drastically erode the expected environmental benefit of these taxes. The OECD database on environmentally related taxes[3] documents 1 500 different exemptions and tax breaks.

Governments have historically manipulated market prices through regulations, taxation levels, government ownership, subsidised loans, purchase commitments, direct and indirect budgetary transfers, trade barriers, set prices, etc. Support measures are put in place to enhance the competitiveness of certain products, processes, industries, or develop the employment and income of social groups or regions. In general, the full economic, financial, environmental and social costs of support measures are not considered, and on balance these costs may often outweigh the benefits of implementing the support measure, thus leading to significant government intervention failures. Recent experiences in OECD

[2] Government intervention failures, also called "policy failures" occur when Governments interventions distort the price system and result in environmental degradation, or worsen situations when such degradation already exists.

[3] www.oecd.org/env/tax-database

countries indicate that the reform or removal of many of these subsidies may not only increase economic efficiency and reduce the burden on government budgets and consumers, but can also alleviate environmental pressures [see below section 4].

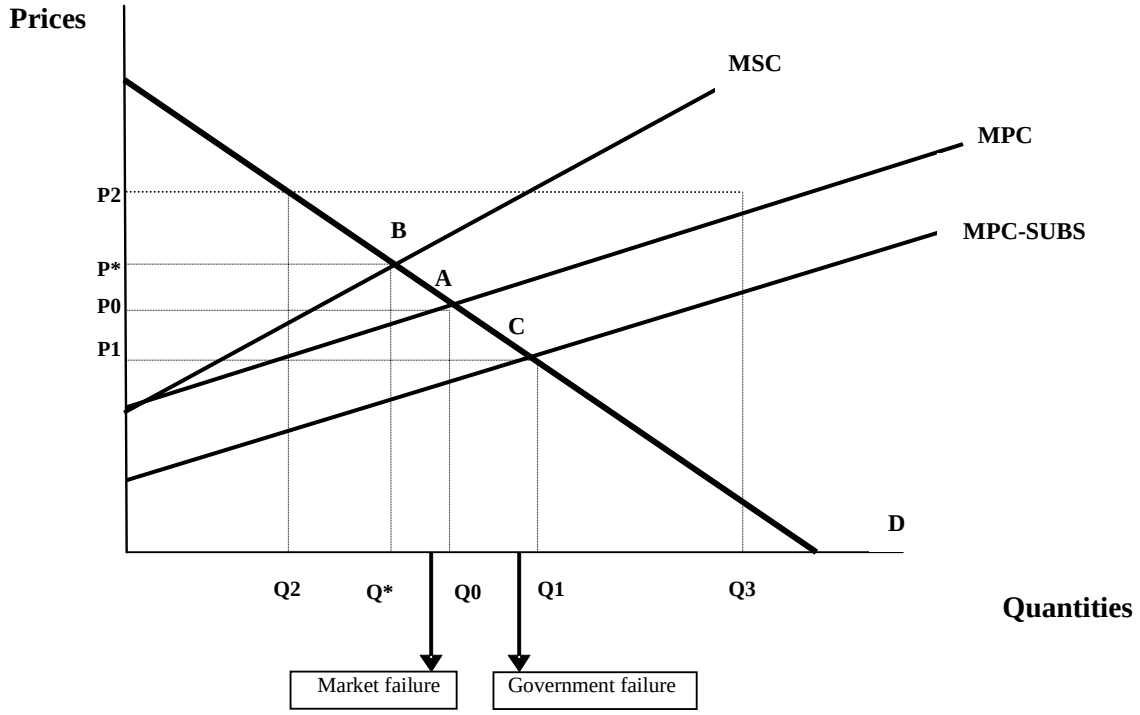
Many policies providing subsidies in OECD countries are implemented in view of supporting environmentally sensitive sectors, particularly agriculture, the fishery industry, energy production, transport and heavy industries. Most of the support measures take the form of cost-reducing support (e.g. support to infrastructure, research and development, material and energy inputs, etc.) or the form of revenue enhancing support (e.g. market price support for particular products). These support measures often lead to increased use of (possibly polluting) inputs and increased production levels as prices for the finished good fall in response to declining costs (OECD, 1998a). Encouraging production augmentation through such support measures increases the risk of environmental damage from production.

In the end, market and policy failures may result in a cumulative detrimental effect on the environment. On Figure 1, the marginal private cost curve MPC intersects the demand curve D so that a quantity Q0 is produced at price P0. Accounting for the external cost associated with the production increases the cost so that the marginal social cost curve MSC (including private plus external cost) intersects the demand curve at point B with a quantity Q*< Q0 produced at price P*>P0. The difference in output Q-Q* represents the market failure.

If a subsidy is paid to the producer, the marginal private cost curve is shifted down to MPC-Subs. Corresponding to a quantity Q1>Q0 and a price P1<P0. The excess production represents the policy failure. In this particular case (other configurations can be conceived), the market and policy failure are added up.

If the government sets a price at P2 to support the producer's income, the government may need to take specific measures to guarantee the purchase of the quantity Q3-Q2 which would otherwise not be purchased at price P2.

Figure 1. Market and government intervention failures



Long-term effects of subsidies are generally different from the short-term ones. There is no technological change in the short-term or substitution between inputs or factors of production. Thus removing subsidies will reduce profits in the short term and cause marginal firms to exit from the market. Removing a long standing subsidy will open the way to the development and application of new technologies hitherto blocked by the subsidy. The technology lock-in effect will disappear in the long term, thus enabling substitution between factors of production and increases in efficiency.

2. DEFINING AND MEASURING SUBSIDIES

2.1 Defining subsidies

The concept of subsidy is not straightforward. While the term "subsidy" is used in this paper, it is as common to use the terms transfers, payments, support, assistance or protection associated with governmental policies in OECD work. Sometimes these terms are used interchangeably, but often they are associated with different methods of measurement and thus different economic indicators. Subsidies have been defined to "comprise all measures that keep prices for consumers below market level or keep prices for producers above market level or that reduce costs for consumers and producers by giving direct or indirect support" [see, for example, de Moor and Calamai (1997) or De Moor (2001)]. This definition is consistent with the OECD approach of defining environmentally harmful subsidies and tax concessions to

include “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” (OECD, 1998a). It is not necessary to make a distinction between subsidies and tax expenditures as the latter can be regarded as implicit subsidies.

Subsidies take different forms: budgetary payments or support involving tax expenditures (various tax provisions that reduce the tax burden of particular groups, producers or products), market price support, subsidised input prices, preferential interest rates. This is why the more generic terminology of “*support measures*” is often used. There is, however, no international consensus: different definitions prevail for specific purposes, fields (e.g. agriculture or transport) or contexts (e.g. international trade).

There has been much controversy over whether the non-internalisation of external costs should be construed as a subsidy, the argument being that, as external cost are not internalised, the environment is used “freely” by the users: in a sense, a public good is freely supplied to users. Those who object to such an expanded definition observe that the notion of a subsidy has traditionally connoted an explicit government intervention, not an implicit lack of intervention. As well, for these and more practical purposes, namely the difficulty of quantifying external costs, non internalisation is not regarded as a subsidy in this paper except for the transport sector where this definition is currently used [Nash et al 2002].

2.2 Measuring subsidies

Five main methods can be used or combined to measure subsidies:

- Programme aggregation: Subsidies are measured by aggregating the value transferred to beneficiaries from government budgets (as often in the case of fisheries, agriculture and processing industries).

- Price-gap: Subsidies are measured by the differential between border and domestic market prices (as in the case of agriculture).

- Producer/consumer support estimate (PSE): This method combines both government expenditures to producers and market price support. The Consumer Support Estimate (CSE) is the analogous indicator for transfers provided to (or from) consumers through government programmes and prices interventions. The OECD uses the PSE and CSE framework to measure support to agriculture and coal.

- The resource rent captured by users of publicly owned natural resources such as minerals, forests and water. These rents estimate the difference between the full economic rent and the price paid for exploiting a natural resource.

- Difference between prices and marginal social cost, in particular in the area of transport.

Although the focus of this paper is not on the different methodologies used to estimate subsidies, it is important to highlight the extent to which methodological differences and data gaps limit the comparability of subsidy figures across sectors (or as the case may be, within a sector). The strengths and weaknesses of the main approaches used in domestic and international subsidy assessments are summarised in Table 1.

The approaches used to estimate subsidies differ in the amount of data required to calculate them and in the degree to which budgetary payments and market transfers are measured accurately. Programme-specific approaches capture the value of government programmes benefiting (or taxing) a particular sector, whether these benefits end up with consumers (as lower prices), producers (through higher revenues), or resource owners (through higher rents). Unless integrated into a macroeconomic model, this information tells little about the ultimate incidence of the subsidy programmes and their effect on market prices. By definition, the price-gap approach highlights observed price distortions, though it misses the often substantial budgetary support that does not affect consumer prices but does effect the structure of supply. The producer and consumer support estimates provide insights into both.

Table 1. Overview of subsidy measurement approaches

Approach/Description	Strengths	Limitations
Programme-aggregation: Quantifies financial transfers associated with various government programmes. Aggregates programmes into overall level of support.	Captures transfers whether or not they affect prices. Can capture the overall cost (which is higher than the direct cost) of government lending and insurance.	Does not address questions of ultimate incidence of pricing distortions. Sensitive to decisions regarding inclusion of programmes. Requires programme-level data.
Price-gap: Evaluates positive or negative "gaps" between the domestic and border prices. Also known as Market Price Support.	Can be estimated with relatively little data. Useful for multi-country studies. Good indicator of pricing and trade distortions.	Sensitive to assumptions regarding "free market" and transport prices. Understates full value of support by ignoring transfers that do not affect end-market prices.
Resource rent gap: Estimates the difference between the full economic rent and the price paid for exploiting a natural resource.	Relevant for natural resource sectors such forest and water.	Data intensive. Sensitive to assumptions.
Marginal social cost approach: Estimates the difference between the marginal social cost (that internalises all externalities) and the price paid.	Most comprehensive approach. Used for transport.	Data intensive. Requires a significant amount of modelling. Sensitive to assumptions and has a wide range of uncertainty.
Producer/consumer support estimate: Systematic method to aggregate budgetary transfers and consumer transfers (through market price support calculation) to specific industries.	Integrates budgetary transfers with market price support into holistic measurement of support. Distinguishes between support to producers and consumers.	Data intensive. Currently calculated for agriculture and coal production, but not for other sectors.

Based on Koplow & Dernbach, 2001.

1.3 Measuring subsidies in environmentally relevant sectors

These different measurements have been applied differently to the main environmentally relevant sectors.

In the field of *agriculture*, the most commonly used definitions and measures of subsidies are the producer support estimate (PSE), the consumer support estimate (CSE), the estimated total

support estimate (TSE) calculated by the OECD and the aggregate measure of support (AMS) used in Uruguay Round and WTO agricultural negotiations. OECD estimates cover market price support, direct payments, (including those to reduce the cost of fixed capital and/or variable inputs), general services (transfers covering the costs of research, marketing and structural/infrastructure services) and consumption support (such as "food stamps" in the United States).

Subsidies to *fisheries* involve a wide range of transfers: examples include grants or loans for the construction of new fishing vessels or the refurbishment of old ones, exemptions from excise taxes on fuel, subsidised unemployment benefits for idled fishermen, non-requited payments for access to fish in another country's exclusive economic zone; government supported exploration for new fishing grounds; and below-cost provision of fishery-specific infrastructure.

Energy subsidies are provided to producers typically through: grants or soft loans for the construction of mines, wells or generating plant; grants for the construction or operation of demonstration plants; government-brokered contracts with large consumers. They are most commonly provided to consumers through differential rates of excise tax or (mainly in developing countries) administered prices for fuels or electricity.

Transport subsidies can be defined in two different ways [Nash et al, 2002]. One way is to compare the total social cost and total revenue for each transport mode in order to assess how far users pay the total cost. The second approach is to compare the marginal social cost and the price paid for the transport mode; the failure of prices to cover marginal social cost is regarded as a subsidy[4].

The main forms of subsidies to *industry* are: grants and interest rate subsidies, tax exemptions, soft loans, equity investments, tax deferrals and loan guarantees.

There are many forms of *water* subsidies. *Water abstraction* is subsidised when water is charged below cost recovery; *Water supply* is also subsidised the same way (pricing below cost recovery) or through direct financial assistance (e.g. for water infrastructure for agricultural or industrial water supply); *irrigation* subsidies are defined either as government expenditure covering all or some of the costs of installing and/or maintaining irrigation systems, or by comparing the price of water with the marginal cost of water supply. Ideally, the price should be compared with the marginal social cost of supply, including the scarcity rent.

3. OVERVIEW OF SUBSIDIES IN OECD COUNTRIES

Many OECD countries have committed to the reform of subsidies in the particular sectors of the economy, but they have made only limited progress over the past ten years. Although the methodologies and coverage differ and consequently the subsidies data are not comparable across sectors, table 2 and figure 1 gives an indication of the importance of support in different sectors. Agriculture is the sector with the highest subsidy figures, but is also the sector with the most complete data in terms of coverage comprehensiveness and methodology. Subsidies measured for the other sectors, such as transport and energy, amount to only a fraction of the figure for agriculture.

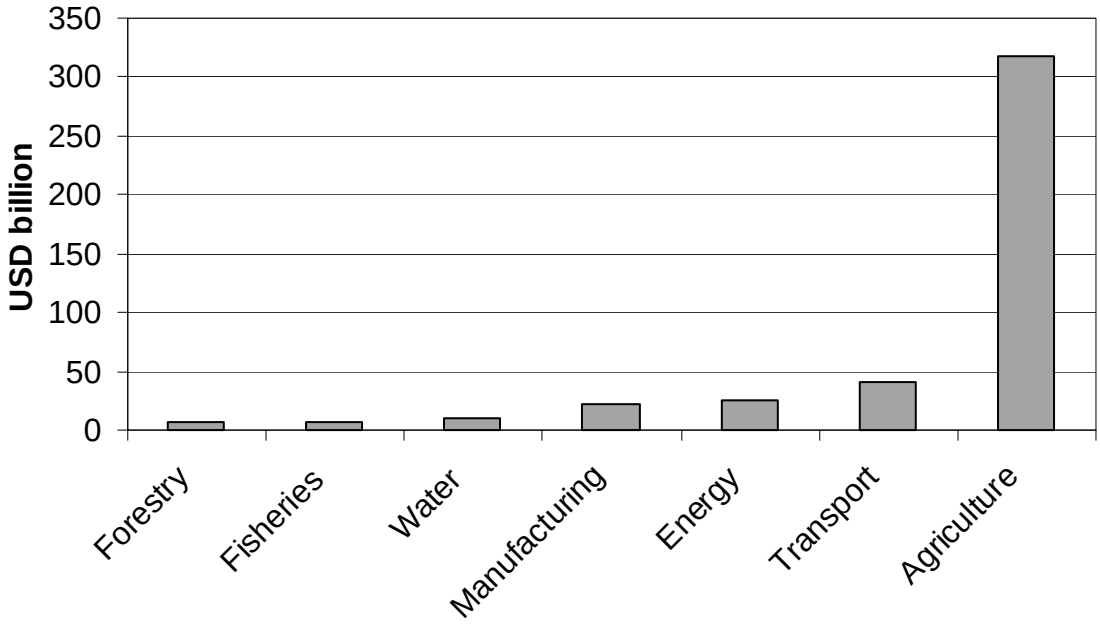
[4] Rana Roy defines a transport subsidy as the revenue foregone relative to the revenue that would be provided by an optimal pricing.

Table 2. Subsidies in OECD countries

	Billion USD			
	1990	Most recent data [year]	Coverage	Comments
Agriculture	351	318 [2002]	Total support estimate; includes market price support, budgetary payments and support for general services; covers all OECD countries.	Equivalent to 1.2% of GDP.
Transport (road and rail)		40 [1998]	Subsidies estimated as the difference between total revenues and total social costs; includes the European Union, Hungary and Switzerland.	Nash et al. (2002) estimated that revenues cover on average 36 % of rail system costs.
Energy production	n.a.	20-30 [1999]	Aggregate estimate.	
of which *- Coal production*	11	5 [2000]	Includes market price support, budgetary payments and support for general services; includes France, Germany, Japan, Spain, Turkey and UK.	Equivalent to USD 68 per tonne of coal produced.
Manufacturing	44 [1993] *49 [1992]*	*22 [EU]*	Net government expenditures to industry. Figures in *italics* cover the EU only and include grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents.	Figures in *italics* from the EU State Aid Survey.
Of which *- Shipbuilding*	.. *2.5 [1995]*	0.75 [2000] *1 [2000]*	Figures in *italics* cover the EU only and include grants, interest subsidies, tax examptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents	Figures in *italics* from the EU State Aid Survey.
- Steel	*2.2 [1995]*	*- [2000]*	Includes grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents; EU only.	Figures from EU State Aid Survey.
Fisheries	n.a. [9 in 1996]	6 [1999]	Government financial transfers to the marine capture fisheries; includes direct payments, cost-reducing transfers and general services. The 1999 figure excludes Australia, Belgium, Mexico, the Netherlands, Poland and Turkey	Equivalent to 20% of landed value.
Water	..	10	Aggregate estimate.	
Forestry	..	6	Aggregate estimate; includes only Canada and the United States .	

Notes: Data and calculation methods are not comparable across sectors.
Sources: OECD (2001b; 2003a), EU (2002), IEA (2001), ECMT (2000a), Nash et al. (2002), Myers and Kent (2001).

Figure 1. Subsidies in OECD countries (most recent years)



Source: based on table 2

4. WHAT MAKES A SUBSIDY ENVIRONMENTALLY HARMFUL?

4.1 A conceptual framework

Most production and consumption activities have an impact on the environment, which are accentuated or attenuated by Government policies. A subsidy is deemed harmful to the environment if it "encourages more environmental damage to take place than what would occur without the subsidy". In other words, the subsidy leads to higher levels of waste and emissions, including those in the previous stages of production and consumption, than what they would be without the support measure (OECD, 1998a). For instance, support to specific agricultural inputs (fertilisers, pesticides, energy) or to specific agricultural prices encourages excess production and environmental pressure; pricing of transport infrastructures below marginal social cost, induces increased traffic; non-taxation of aircraft kerosene accelerates growth of air transport and related environmental damage; subsidised (or under-taxed) energy increases CO2 and other polluting emissions; under pricing of water resources result in water shortage and salinisation of soil. However, These "volume effects" are environmentally harmful as long as the associated externalities are not internalised, hence the influence of the "environmental policy filter" (see below).

Removing environmentally harmful subsidies would result in a better environment, however, this depends on the factors determining the magnitude of environmental effects of support measures (OECD, 1998a), i.e.

1. The level of protection from competition that support measures offer the recipient sector, in other words, the extent to which alternatives to the recipient sector are discouraged.

2. The environmental effects of the alternative products or technologies that are discouraged by the support measure, compared with those of the supported sector.

3. The circumstances that determine how sensitive the environment is to the particular change in emission or waste levels brought about by the support measure.

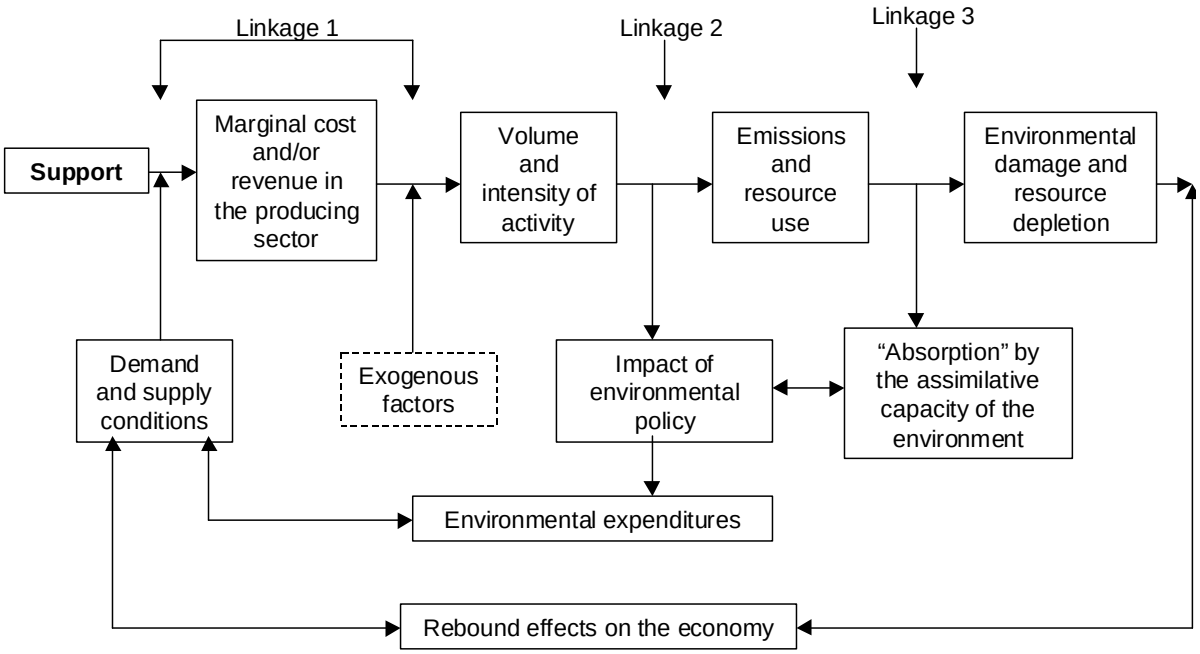
These factors highlight the division between what governments can change, such as support policies and, to some extent, the emergence and use of cleaner technologies; and what they cannot influence, such as the dose-response relationship between particular emissions and environmental quality (OECD, 1998a). The environmental impact of support measures result from complex mechanisms that are far from being fully elucidated. There is no direct linkage between the volume and nature of the subsidy and the environmental impact.

On figure 3, *linkage 1* is the link between the support measure and the volume and composition of output; this linkage includes complex interactions: for instance, the support measure will benefit one sector or one production technique relative to others or a transfer of resources from taxpayers to producers or between consumers and producers. Furthermore, other "autonomous changes "such as technical change and economic development will interfere with these linkages.

Market price support (e.g. floor price with specific measures to guarantee purchases at this price) affects the *revenue* of the recipient sector (typically the case of agriculture). This may result in increased production volumes because the greater the volume of production the higher is support received by producers. A "leakage effect" is also likely, as the increased volume of production may induce extra use of inputs (e.g. fertilisers), thus transferring (part of) the increased revenue to the input suppliers, but also having an environmental impact by changing the production process (more intensive farming).

Support measures targeted on the use of specific products or inputs (e.g. energy tax exemptions of heavy industries), or on the use of particular production processes (e.g. low-interest loans for the construction of intensive livestocks), *reduce production costs*. Depending on market structure and international competition, products could be sold at lower prices, thus increasing consumption and possibly environmental impacts.

Figure 3. Linkages between support measures and environmental effects



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: Based on OECD (1998a).

Linkage 2 relates to the level of emissions resulting from the changes in the volume and composition of output. This is a function of production and emission abatement techniques of the polluting sector and the type and effectiveness of the environmental policy in place (the environmental policy "filter"). Environmental expenditure will then have a rebound effect on the economy (multiplier effect).

Finally, the environmental impact of increased emissions will be a function of dose-response relationships and the assimilative capacity of the environment (*linkage 3*). Those environmental impacts will also produce rebound effects on the economy e.g. health effects, depletion or deterioration of natural resources, higher production costs etc.

This analysis shows the complexity of the linkages between support measures and environmental impacts. A thorough assessment would require a complex set of general equilibrium analysis (to evaluate the rebound effect on the economy) and environmental impact evaluation techniques.

It is important to analyse subsidies separately from their objectives. Subsidies are generally introduced for a "good", or at least politically rational, purpose. But the Devil, i.e. the difference between a "good" and a "bad" subsidy, is in the details on how they are implemented (Pieters, 2003). It should be assessed whether subsidies serve the intended purpose, at what cost, how the costs and benefits are distributed and whether they are harmful for the environment.

Many existing subsidy policies do not even serve effectively their intended purpose. For example, most subsidies for energy or water that are ostensively meant to protect poorer members of society, end up benefiting the rich or create major inefficiencies in the economy (see section 5). Subsidies to road transport often encourage motor vehicles overuse and increase pollution and congestion. Agricultural subsidies are an expensive and inefficient ways to maintain farm incomes, especially for small farms. Thus subsidies are often inefficient and expensive policies that are environmentally harmful and

impose a burden on government budgets and taxpayers. All these are strong arguments for reforming the existing subsidy policies. Decoupling subsidies from input use, production and consumption would bring economic, environmental and social benefits. Table 3 highlights the expected environmental effects of removing different types of subsidies.

Table 3. Environmental impacts of subsidies removal

Categories	Main points of impact	Environmental effects[1)]		Remarks
		Short term[2)] reduction in emissions or rates of exploitation, due to:	Long term[2)] reduction in emissions or rates of exploitation, due to:	
1. Output	Market price support	Lower production levels	Lower production levels	Consumer prices will drop. Less input requirements may lead to strong environmental effects in the production of materials and energy phase. Production may shift to areas of low cost production, leading to a possible displacement of the environmental burden
	Deficiency payments, sales premiums	If marginal revenue falls below marginal cost, the least efficient production units will exit from the market	Higher product price, on the other hand, increased efficiency may lead to different modes of production that may, or may not be more environmentally damaging	
2. Input use	Materials, energy, short-lived equipment	Higher marginal costs for subsidised "firms" Least efficient production units exit from the market, if marginal revenues drop below marginal costs	Lock-in effect disappears, allowing substitution and savings on inputs. If accompanied by effective environmental policies this creates a window of opportunities for environmental improvement[3)]	Strong effects may be expected due to reductions in the production of materials and energy or rates of exploitation that often are relatively environmentally harmful
	Particular types of fixed capital	Exit of the least efficient production units, if marginal revenues drop below marginal costs	Disappearance of the lock-in effect, depending on the specificity and duration of the conditionality	If substitution of capital equipment opens the way to more efficient use of materials or energy (or the substitution of less harmful ones), strong effects upstream may be expected
	Access to natural resources	Increases the price of natural resources for downstream users, increasing their resource efficiency	Higher barrier to entry or disappearance of the least efficient production units, or both	Strong effects on entry with possibly large beneficial effects on rates of depletion
	Low interest loans	Possibly a (limited) effect on marginal costs	Higher barrier to entry or disappearance of the least efficient production units, or both	
	Research and development		Deployment of environmentally more benign technologies, if accompanied with effective environmental targets.	If the subsidy is large, it may be an exploitation subsidy to capital costs in disguise. In those cases the effects are unclear

3.	**Profit and income**[4)]	Preferential low rates of income taxes; Preferential low rates of capital taxes; Debt write-off	Possibly somewhat lower marginal costs. If so, exit of the least efficient production units, if marginal revenues drop below marginal costs	Higher barrier to entry. Higher prices reduce demand	
		Allowing insufficient provision for future environmental liabilities; Exemptions from environmental standards	Exit of the least efficient production units, if marginal revenues drop below marginal costs	Higher consumer prices and more environmentally benign modes of production	
		Low rate of return requirements		Higher consumer prices and higher internal discount rates. The latter shortens the planning horizon of the "firm" and thereby the lock-in effect	
4.	**Demand**	Low rates of VAT, Marketing and promotion by government	Exit of the least efficient production units, if marginal revenues drop below marginal costs	Undetermined, since dependent on externalities	Some "up stream" effects may be expected
		Provision of infrastructure below costs	The same as above	The same as above More decentralised production close to the place of consumption; different technologies	The environmental effects depend also on site specific environmental conditions

1) As stated before, elements of the policy filter (quota, limitations in infrastructure) may become, or remain the limiting factors to production and thereby to the environmental effects of subsidy removal. In this table this is ignored.
2) In the sort run, technology remains the same. That is, there is no substitution between factors of production or inputs for that matter.
3) Choosing a particular input often casts the technology in stone and vice versa.
4) Removal of subsidies based on historical entitlements, or direct payments to producers in exchange for production (modes) that are environmentally beneficial have been omitted from the table, because such removal is likely to damage the environment.

Source: adapted from Pieters (2003).

Not all subsidies are bad for the environment. Road transport and pollution would increase if the other modes of transport were not subsidised (public transports). Some subsidies are used to support the generation of environmental benefits. OECD countries are increasingly linking agricultural support payments to farmers' action to improve the environmental performance of agriculture. Some countries pay farmers who limit the use of environmentally damaging inputs, such as certain fertilisers and pesticides, or those who use organic farming techniques. Others support farmers in planting trees to reduce agricultural runoff and provide habitat for wildlife, in removing marginal land from production, or in creating or restoring wetlands, which reduces soil erosion and creates wildlife habitat. There are also substantial programmes in OECD countries that support the development and production of renewable energy sources. However, all of these subsidies are higher than would otherwise be needed, in so far as they are used to offset the environmental damage caused by other policies that stimulate environmentally harmful production, and many are not well targeted to achieve specific environmental outcomes.

Studies on the environmental impacts of subsidies use different models, assumptions and data, and consequently the estimates are not directly comparable (Steenblik 2003). However, they do give a good indication of the range of findings available from different studies on removing support in different countries, with different assumptions and timescales. Most studies show that removing support will have a positive effect on the environment, although sometimes the predicted effects are quite small. The environmental impacts of subsidies can be estimated with a partial or general equilibrium model, and the

results are typically sensitive both to the model chosen and to the magnitude of the subsidies data used as model inputs.

Subsidies may have different initial points of impact, such as output, input, profits and income. Initial points of impact matter for two reasons. Subsidies to inputs affect other markets than subsidies to outputs or profits and income. Generally speaking, subsidies that directly impact material flows have more direct effects on forward linkages than subsidies to output or profits and income. Such subsidies also leave less options for more benign modes of production than subsidies to output or income (OECD, 1998a). Also, if input subsidies are conditional on the use of particular energy carriers or materials (including water), or particular types of capital equipment that require only certain types of energy carriers or materials, they will discourage materials and energy saving, on which the success of environmental policy is highly dependent.

Environmental management regimes and other elements of the "policy filter" affect the environmental impacts of subsidies. If for example subsidies to fisheries are removed while catches are limited by other measures, or when certain types of subsidies to road or energy are removed, while infrastructure is a limiting factor, the environmental effects of removal may not be significant (Hannesson, 2002; ECMT, 2000a).

4.2 Trends in environmentally harmful subsidies

Environmentally harmful subsidies are prominent in fossil fuels, road transportation, agriculture, water forestry and fisheries.

Agriculture

The impacts of agricultural support measures on the environment depend on their effects on farm-level decision-making concerning the *intensive* (input use) and *extensive* (land use) degree of agricultural production. These impacts result from the relationships linking land quality, production practices, input use and environmental quality defined in terms of, for example erosion, chemical run-off, leaching, landscape and biodiversity or wildlife habitats.

In general, the more a policy measure provides an incentive to increase production of specific agricultural commodities — the greater is the incentive for *monoculture*, intensification (greater yields), or using marginal (environmental sensitive) land — and the higher is the pressure on the environment. However, some restrictions or constraints on providing support (e.g. environmental cross-compliance[5] and regulations) may attenuate the environmental impacts of support measures. Moreover, the more a policy measure can be targeted to a specific environmental goal and situation, the greater is its potential *effectiveness* in achieving such a goal. The analytical work on the Producer Support Estimate, the Policy Evaluation Matrix (PEM) and on the impact of support on environment allow to rank support measures according to their relative impacts on the environment [(OECD, 2002c) and Portugal (2002)]. Details on the ranking are showed in Box 1.

In 2002, estimated total support to agriculture amounted to USD 318 billion (OECD, 2003), which represents 1.2% of GDP in OECD countries. During the 1990s many OECD countries began to take steps to reduce and restructure their support policies in an effort to reduce overproduction and trade distortions, and to encourage more environmentally sound use of land, soil and water. The pace of these developments has been modest and subsidies remain high in many OECD countries and for some

5 . Support conditional upon farmers undertaking some type of environmental compliance.

commodities, causing adverse effects on the environment. In 2002, support to farmers represented 31% of the value of farm receipts, compared with 38% in the 1986-1988 period (OECD, 2003a).

Box 1. Relative potential impacts of agricultural producer support measures on the environment

All other things being equal, the main categories of PSE measures can be ranked according to their relative impacts on the environment as follows:

Market Price Support and ***Payments based on output*** both increase the price received by producers for a specific commodity such that the more the commodity is produced, the higher will be the support. Thus, the higher these forms of support, the greater is the incentive for monoculture, for increasing the use of inputs (such as chemicals), and/or for using environmentally sensitive land, and the higher is the pressure on the environment**.** Moreover, these payments have the lowest effectiveness in achieving environmental goals, as they are sector-wide payments that can not be targeted to any environmental goal or situation that are generally local.

Payments based on input use reduce the cost of inputs used by producers such that the more the input is used the higher will be the support. Thus, the higher these payments, the greater the incentive to use the input, and the greater the impact on production and the environment. The more the payment is specific to a variable input (*e.g.* fertiliser, pesticide) the greater the incentive for production intensification, and the pressure on the environment. For example, the environmental impact of a credit subsidy for purchasing fertilisers or pesticides is potentially higher than a credit subsidy for acquiring farm land or extending farm buildings. Therefore, these payments may have a higher, the same, or a lower effect on production and the environment than an output payment depending on the type of input on which the payment is based.

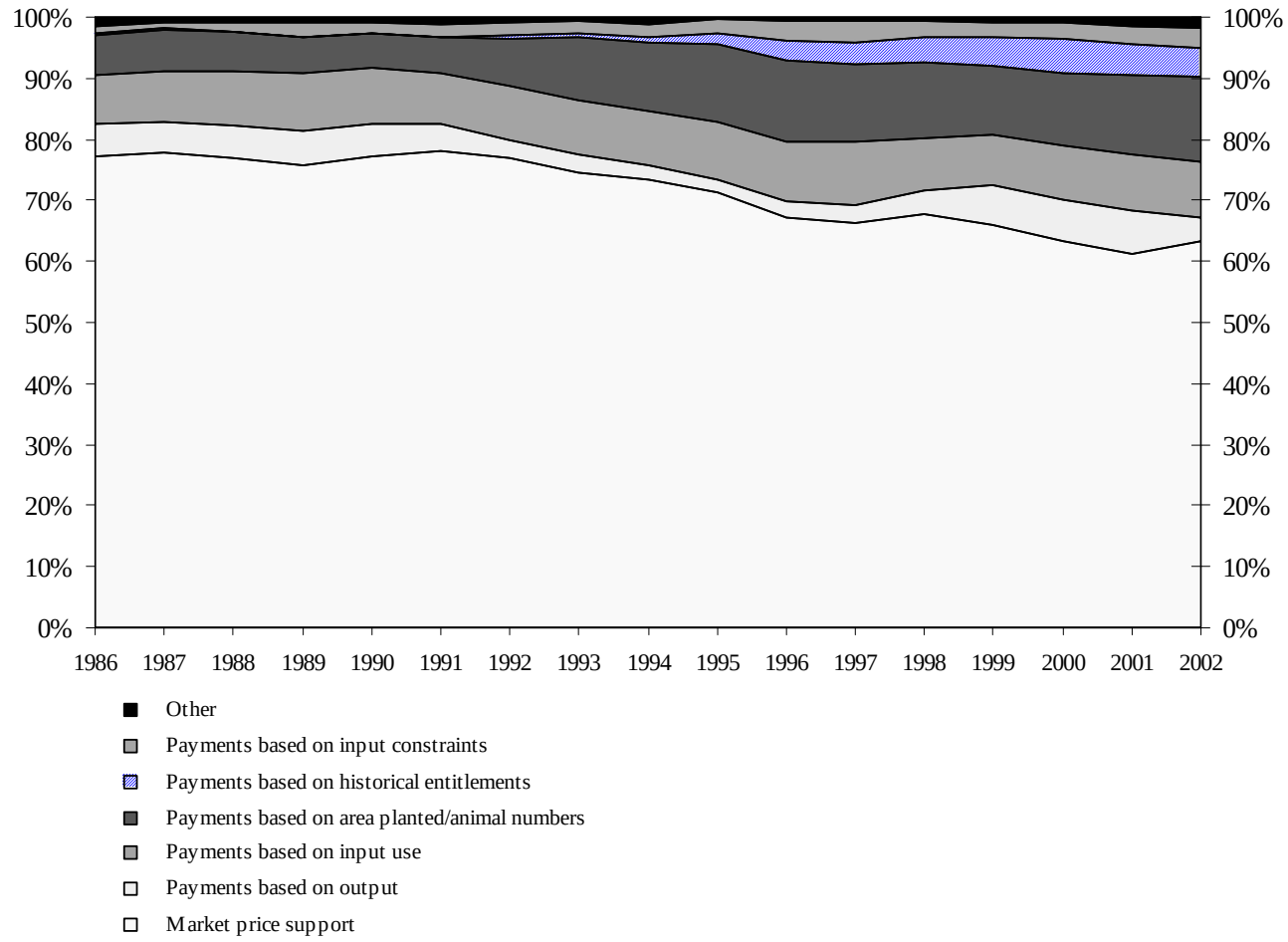
Payments based on area planted/animal numbers reduce the cost of land/livestock for current plantings/ animal numbers. As producers have to plant a specific crop or own specific animals, these payments may be an incentive for keeping environmental sensitive land producing commodities non-environmentally-friendly in such land. Although these payments may be targeted to a specific environmental goal or situation, they provide an incentive to bring additional land or animals into specific production and encourage monoculture in the same way as the payments based on output. However, as producers are not encouraged to increase yields and to produce as intensively as they are with the forms of support outlined above, the environmental impact of these payments is potentially lower.

Payments based on historical entitlements (i.e. past support, area, animal numbers, production, or income) and ***payments based on overall farming income*** (paid on the condition that the overall farmers' income is below a pre-defined level) also have the potential for retaining environmentally sensitive areas under production. However, as to receive these payments producers are not obliged to plant, own animals, or produce any particular commodities, they allow for individual choices on environmentally friendly production techniques, and do not encourage production intensification and/or monoculture. Therefore, the impact of these payments on the environment are relatively benign or lower than the previous forms of support.

Payments based on input constraints are paid on the condition that farmers respect certain constraints (reduction, replacement or withdrawal) on the use of inputs often for environmental purposes. These payments may be targeted to specific environmental situations to address specific environmental issues associated with agriculture. They may contribute to offset the reduction on a positive environmental impact or the increase on a negative environmental impact of farming activities often benefiting from one or more of the previous forms of support. These mainly through input constraints that reduce production intensity, encourage production diversification, or put environmentally sensitive land aside from production relatively to which otherwise would occur. The environmental impacts of these payments depend on the type of constraint, but they have the potential for reducing environmental pressure and for being the most environmentally effective PSE measures.

Source: OECD (2002b) and Portugal, Luis (2002)

Figure 4. Composition of Producer Support Estimate (PSE)
(1986-2002)

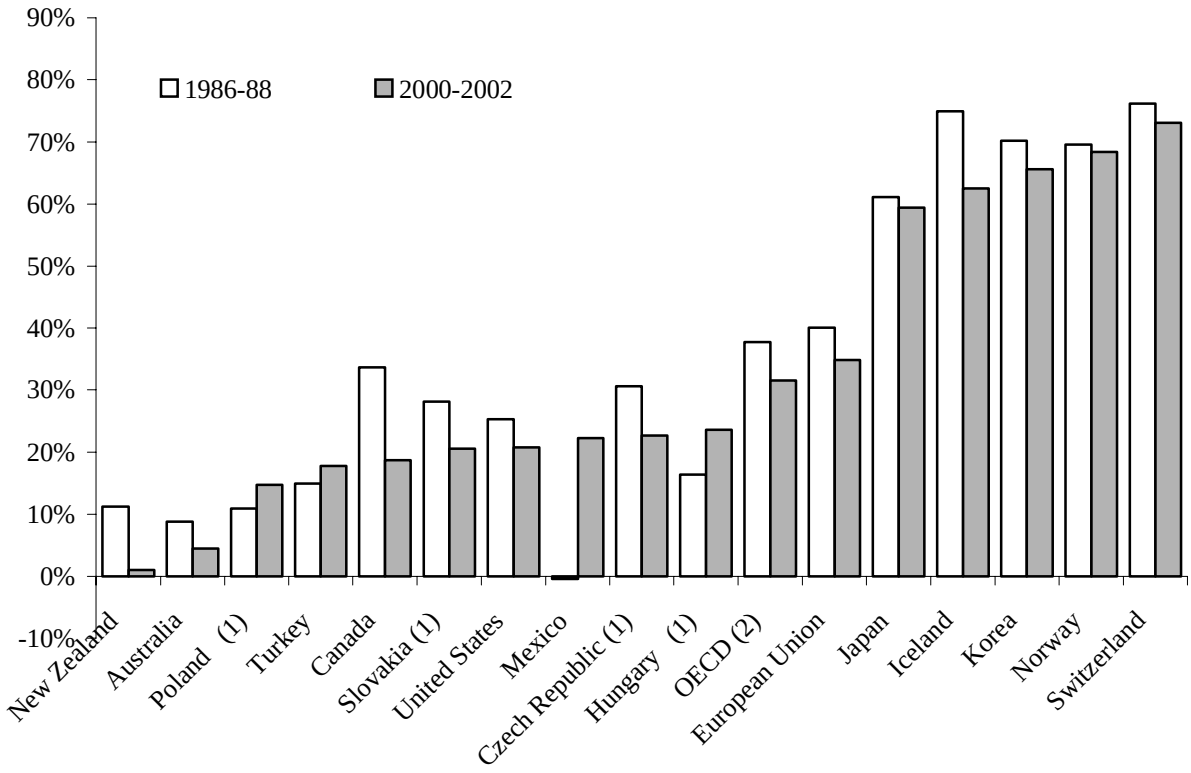


Source : OECD, PSE/CSE database, 2003.

The share of market price support, output payments and input subsidies (such as water, fertilisers and energy subsidies), which are potentially the most environmentally harmful types of support, has decreased marginally since the mid-1980's, but they still account for nearly 80% of total support (the bottom three categories in Figure 4). This share varies across countries, and is highest in the countries with the highest levels of support (Figure 5). While the share remains persistently high in Korea and Japan, it has decreased in Iceland, Norway and Switzerland due to a shift to less distorting support (OECD, 2003a).

Figure 5. Producer Support Estimate by country

(Percent of value of gross farm receipts)



Notes: Countries are ranked according to 2000-2002 levels.
1. For the Czech Republic, Hungary, Poland and the Slovak Republic 1986-88 is replaced by 1991-93.
2. For 1986-88, the Czech Republic, Hungary, Poland and the Slovak Republic are excluded.
Source: OECD, PSE/CSE database, 2003.

Fisheries

According to Hanneson (2002), it is difficult to find more perverse policies, in terms of efficient resource utilisation, than fisheries subsidies. The basic problem in fisheries management is that too much capital and labour are used in the industry, and subsidisation only aggravates the problem. A distinctive feature of fisheries sector subsidies is the effect that over-capacity and over-fishing by subsidised producers can have in limiting other producers' access to the shared resource.

The environmental impact of fisheries subsidies depends on the management regime in place or the "policy filter". Most fisheries in OECD countries limit total catches, but very few apply truly effective management, which typically includes entering restrictions for particular fisheries, such as having to buy one's way in through buying and scrapping somebody else's licensed boat. Over time there has been a movement in many countries from catch control to effective management.

The OECD countries have supported their fishing industries with significant amounts of money and over long periods of time. Subsidies for fisheries in OECD countries amounted USD 6 billion in 1999 (OECD, 2001b). This corresponds to 20 % of the value of landings. Japan provides the largest fisheries subsidies in the OECD, followed by the European Union, United States, Canada, Korea, Spain and Norway.

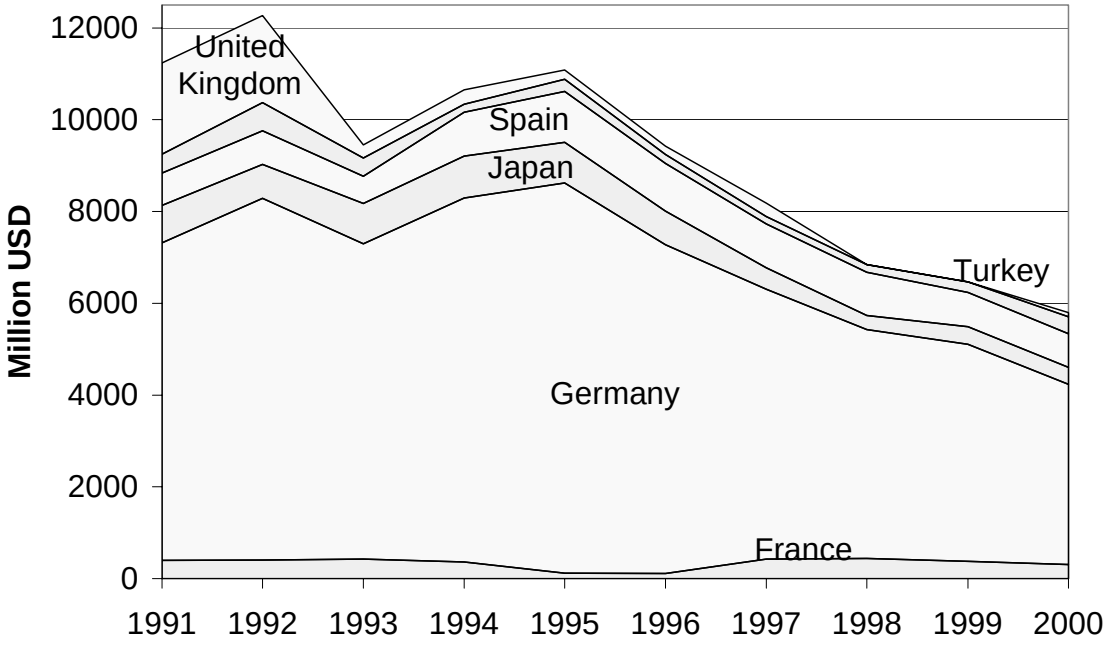
Most of the government financial transfers in the OECD countries are for general services. Expenditures on research, management and enforcement activities are important as they can contribute to ensuring the sustainable use of fish stocks and the aquatic ecosystem. In some countries, however, bulk of the expenditure on general services is on fisheries infrastructure and fisheries enhancement programmes that can contribute to over-fishing (Cox, 2002). The introduction of cost recovery programmes for some research, management and enforcement expenditure in some countries implies that some of these activities directly benefit fishers, rather than society as a whole. Capacity-reducing transfers, including vessel buyback programmes, licence retirement schemes and payments to fishers to leave the industry, have been widely used in OECD countries in response to over-fishing and over-capacity (Cox, 2002).

Energy

Energy subsidies are widespread in all countries. For a long time, governments have manipulated energy prices through regulations, taxes and direct and indirect support, for the purpose of energy security, the diversification of domestic energy sources and social concerns (e.g. keeping low energy prices, subsidising coal mines). Estimates of support for coal production are more systematic and complete than for other forms of energy. Total support to coal industry in the OECD countries decreased through most of the 90s from USD 11.4 billion in 1990 to USD 5.4 billion in 2000 (IEA, 2001). Germany and the United Kingdom are the countries with the biggest decreases in support (Figure 6). This reduction in support was accompanied by an even larger reduction in coal production over the same time period and, consequently, support *per tonne of coal equivalent* increased in some countries (Figure 7).

The negative environmental consequences of coal subsidies are obvious in terms of air pollution, but also soil degradation, toxic waste and water pollution. Generally speaking, subsidies that increase fossil fuel consumption through lower prices result in higher emissions of greenhouse gases and other pollutants (SOx, NOx etc.).

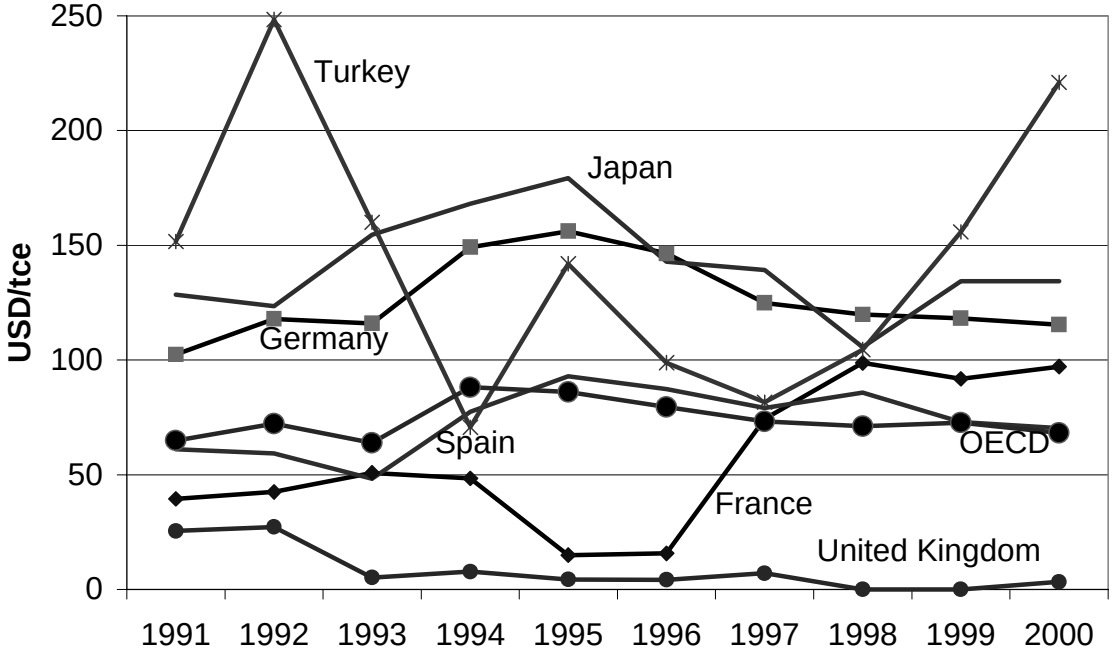
Figure 6. Support to coal in selected OECD countries
Million USD



Source: IEA.

It should be noted that energy subsidies in *non-OECD countries* are twice the absolute level of OECD countries. IEA (1999) has simulated the effects of removing energy subsidies in eight non OECD countries (China, Russia, India, Indonesia, Iran, South Africa, Venezuela and Kazakhstan), where the average subsidisation is 21%. The results indicate on average: a 0.76% increase in GDP, a 13% decrease in energy consumption and a 16% reduction of CO2 emissions.

Figure 7. Support to coal in selected OECD countries
USD/tce



Source: IEA.

Manufacturing

There seems to be a trend away from subsidies for particular industry sectors towards more horizontal objectives, including regional development, research and development (R&D) and small and medium-sized enterprises (SMEs) (OECD, 1998b). Indirect means of support, such as public procurement, R&D contracts, and R&D intermediary institutions, channel far more financial resources to manufacturing industry than does direct support. Even if the support element in indirect measures only represents a very small percentage, it would still be very significant. As there is no agreed methodology for measuring the support element in indirect support, uncertainties remain as to its role as a policy instrument and, more specifically, as a tool of support to manufacturing industry.

Programmes intended to support one or selected manufacturing sectors are of special interest from the environmental point of view. Most sectoral programmes target the shipbuilding industry. Other industries where sectoral programmes are common include fish processing, textiles and the steel industry. The support for the aircraft and space industries is also channelled through R&D programmes, equity capital injections and intermediary space agencies. There has been no systematic efforts to assess the environmental impacts of manufacturing subsidies.

Support to manufacturing, measured in constant prices declined in 1986-1989, reaching USD 37 billion in 1989 (OECD, 1998b). The support peaked at USD 45.7 billion in 1991 before declining to USD 43.7 billion in 1993. There was a 24% growth in support in nominal terms from 1989 to 1993, corresponding to a 4% decrease in constant terms during the period (OECD, 1998b). There are, however, no recent figures available.

Transport

Subsidies for road and rail transport in the European Union, Hungary and Switzerland amounted to about USD 40 billion in 1998 (Nash *et al*., 2002). The estimate is based on a broad definition of subsidies that compares total revenues with total *social* costs for each mode of transport. In nearly all countries, revenues from road transport cover the cost of providing and maintaining the infrastructure. In many countries these revenue cover total social cost [Nash *et al* 2002]. However, as mentioned earlier, another approach is to compare the marginal social cost with the price paid; this shows that road transport is often charged much below marginal social cost. Rana Roy (in ECMT, 2003) made calculations of the optimal transport pricing in urban areas for five EU countries; for cars, this indicates, for example, that optimal prices would imply an increase in peak-period prices of about 70 % in the Paris sub-urban area (Ile de France), 95 % in Munich and over 150 % in London. According to Roy, this price increase would provide significant fall in car passenger kilometres and significant welfare gains.

On the other hand, as other modes of transport (e.g. rail) are heavily subsidised, phasing out these subsidies would divert traffic from rail, to road. Although there might be some reduction in the total amount of transport, the increase in road transport would have negative effects on the environment. According to Nash et al. (2003), passenger and freight revenues cover, on average, 36 % of rail system costs.

Water

Water-related subsidies can take several forms and cause a series of environmentally harmful consequences (see table 4). According to Mona Sur *et al* (2002), farmers across the world seldom pay more than 20 % of the full cost of water, thus encouraging wastage, groundwater depletion, pollution, soil salinisation and reappearance of virulent forms of malaria. They also claim that "full (cost) recovery, to the best of our knowledge, including the recovery of the full investment cost, has not been practiced anywhere."

Table 4. Some examples of possible environmentally harmful consequences of water-related subsidies

Description of the subsidy	The mechanism through which it may harm the environment	How it may harm the environment
Agricultural price support policies	Incentives for farmers to grow water-inefficient crops in unfavorable environments.	Salinization, water-logging and/or decline in groundwater tables.
Surface water price	Overuse of water and cultivation of water-inefficient crops. Use of inefficient technologies.	Pollution and depletion of water bodies. Salinization, elevated levels of water tables & drainage problems.
Electricity price	Substitution of surface water (SW) with GW, especially in places where SW supply is inadequate or irregular. Overuse of groundwater due to excessive pumping.	GW levels are lowered, aquifers are depleted and contaminated via intrusion of low quality water from adjacent aquifers or sea water intrusion.
Pesticide prices	Overuse of pesticides and inefficient application management practices leading to high rates of pesticide leaching.	Pesticides contaminate GW aquifers and may create irreversible health damages.
Fertilizer prices	Overuse of fertilizers and inefficient application management practices leading to high rates of fertilizer leaching.	Fertilizers can increase soil salinity and contaminate GW aquifers. They may also adversely

		affect the development of infants.

Source: Mona Sur, Dina Umali-Deininger, Ariel Dinar, "Water-related Subsidies in Agriculture: Environmental and Equity Consequences", OECD workshop on Environmentally Harmful Subsidies 7-8 November 2002, Paris.

5. CONCLUSION: THE POLITICAL ECONOMY OF SUBSIDY REFORM.

Subsidies are at the core of the sustainable development paradigm in a complex and paradoxical manner. On the one hand, while it is largely recognised that sustainable development implies, *inter alia*, well functioning and non distorted markets, subsidies constitute a prominent form of market distortion; on the other hand, support measures may be needed to start a virtuous cycle of sustainable development, for instance to help certain economic sectors or regions; such measures should be transitory with a firm sunset clause. Subsidies also have a long, complex and somewhat chaotic history; they have been introduced over decades, often under political pressure, often without a long term strategic vision, for a variety of economic and social purposes: protecting economic sectors from international competition, supporting employment or income of segments of the population (coal miners, farmers etc.). Whilst it is now widely recognised that subsidies are costly, often inefficient, distorting and, in a number of instances, environmentally harmful, reforming and phasing out these subsidies faces formidable challenges.

5.1 A political challenge

Inherited habits, political, social and institutional barriers to subsidy reform result in what van Beers and de Moor (2001) call "addiction to subsidies". Removing subsidies faces strong economic barriers such as: lock-in technologies (removing the subsidy would force technical change when the subsidy is targeted on a specific technology, thus stifling innovation); rent seeking and vested interests. The fear of loss in competitiveness is also prominent, e.g. concerning *tax exemptions*, in particular in the energy sector. Van Beers and de Moor also underline the institutional barriers such as: purchase of votes by politicians through subsidies, creation of institutions and bureaucracy in charge of the management of subsidy schemes (removing the subsidy would imply laying off the employees in charge of the scheme), the fear of political instability. For instance the Chicago Convention on Civil Aviation (1944) introduced the de-taxation of kerosene in 1953 (a typically environmentally harmful subsidy). This exemption should be phased out, but it faces strong resistance from vested interests (e.g. airlines). Furthermore, this would involve an international conference to seek a new consensus among all parties or the re-negotiation of a large number of bilateral treaties (van Beers and de Moor p. 73). The current difficulties and slow progress in the reform of the EU common agricultural policy is an example of political barriers; even keeping income support to farmers, while changing its nature and purpose faces vigorous opposition.

Overcoming these obstacles requires careful implementation strategies. These could include, in particular (OECD 1998a):

- Addressing the effects on equity and employment, for instance through compensatory payments to the stakeholders affected by the subsidy removal; these payments should be decoupled from output levels an be temporary for instance to ease the transition of workers towards new employment opportunities.

- Implement a transparent and co-operative reform process, in particular through a reliable and transparent data and indicators on subsidies and their detrimental effects and a clear exposition of the objectives and benefits of the reform.

- Implement a progressive reform involving all stakeholders over a carefully planned period.

- Resolving the international competitiveness issue, when removing a subsidy in a given country would affect the competitiveness position of the concerned sector. A case in point is the current prevalence of energy tax exemptions of industry in OECD countries (1 500 cases of exemptions recorded in the OECD database on environmentally related taxes). Many exemptions have been introduced to protect certain industry (particularly energy intensive) sectors. Progress can only be expected if it is possible to achieve an internationally concerted action (OECD 2001a).

Also, all new subsidies should include a sunset clause, making sure that after a given period they would be automatically phased out.

5.2 A social challenge

Subsidies are often designed for social reasons (e.g. to protect poorer segments of the population), one of the three "pillars" of sustainable development. This social concern may often work against sound environmental management, for instance when subsidised water prices result in wastage and salinisation of soils. The social justification of *water subsidies* is particularly questionable in *developing countries*: in urban areas, subsidised water supply benefit primarily relatively wealthy families who have access to the urban water supply system, while poorer families, in rural areas still lack access to potable water (de Moor, 1997). Subsidised irrigation water, often proportional to the surface of land owned, tend to benefit richer farmers. In fact, increasing water prices in developing countries are likely to generate social benefits. The willingness to pay of poor people for adequate water supply is high [World Bank 1992]. In practice, the prices of privately sold water on which poor people must rely are much higher than water supplied through proper supply infrastructures (up to 12 times higher,- FAO 1994). A 1994 World Bank study shows that 80 to 90 percent of the richest quintile of the population in some developing countries had access to public water supply, while only 30 to 50 percent of the lowest quintile have access (World Bank 1994, cited by de Moor 1997).

The appropriateness of *energy-related subsidies* can also be questioned. For instance, coal subsidies may not be the best way to maintain social cohesion: subsidised coal mines often produce coal several times more costly than imported coal (IEA 1999). The social implications of removing energy subsidies are not straightforward; higher energy prices can be *a priori* construed as socially regressive, but, in the case of motor vehicles, in developing countries car owners tend to be concentrated in the higher income segment of the population.

5.3 A challenge for the developing world

Subsidies in OECD countries affect the development of non-OECD countries. For instance, agricultural subsidies create a barrier for the import of agricultural products of developing countries. Subsidies in the developing world can cause the depletion of natural resources. Subsidies to fisheries result in over-fishing, not only in OECD countries, but also in developing countries; for instance, the European Union has agreements with a number of developing countries to fish in their coastal waters, with subsidised highly efficient, sophisticated fishing vessels.

Clearly, environmentally harmful subsidies are a global challenge for sustainable development as their economic, environmental and social effects are pervasive throughout the world. This has been recently recognised by the World Summit on Sustainable Development (Johannesburg September 2002) which calls upon countries to "promote energy systems compatible with sustainable development through

the use of improved market signals and by removing market distortions, including restructuring taxation and phasing out harmful subsidies."

5.4 A technical challenge

As explained in this paper, assessing the environmental impact of environmentally harmful subsidies is technically complex. Yet, dealing with this complexity this is an essential step to pave the way for the reduction or removal of these subsidies. Considerable work needs to be done to get a clearer picture and develop effective analytical tools. An OECD workshop on environmentally harmful subsidies (OECD 2003) concludes that further work should include:

- supplementing and updating existing databases on subsidies and exploring the fuller inclusion of subsidies in National Accounts;
- improving the conceptual framework for analysing the environmental impact of subsidies and testing a "checklist" designed to assess the environmental impacts in various sectors (such as energy, water, transport, agriculture);
- strengthening co-operation between the various institutions working in this area; and
- examining the role of subsidies in the broader context of sustainable development, in order to understand the possible synergies and tradeoffs in subsidy reform.

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