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UK's climate change levy: cost effectiveness, competitiveness and environmental impacts ☆

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Abstract

This paper intends to examine the cost effectiveness of UK's climate change levy (CCL), its implications on competitiveness of firms and the environmental impact. The paper briefly describes the levy and analyses it under the cannons of a good taxation policy. The economic implications of the levy are discussed with theoretical and empirical perspectives. Change in net exports, investment patterns and productivity and inclusion of compliance cost forms the basis for analysing the effect on competitiveness. It discusses the options available to firms to safeguard their competitiveness if it is adversely affected by the CCL. A description of the current scenario of the levy since its inception is also presented. The paper argues the need for a comprehensive policy involving the use of standards, emission trading as well as energy taxes to achieve emission and energy-use reductions. A focal point of this paper is to elucidate the pros and cons of the CCL (energy tax) with respect to an emission trading scheme.

Keywords: Energy taxes; Competitiveness; Climate change levy

1. Introduction

In recent years it has become increasingly clear that expanding economic activity can impose serious environmental damage that is global in dimension and irreversible over long time horizons. As represented by the Intergovernmental Panel of Climate Change (IPCC, 2001), the majority scientific view is that the greenhouse effect[1] will cause significant global warming by the middle of the next century in the absence of policy intervention. International concerns over this issue have elevated energy policy to the forefront of environmental policy agenda. The late 1980s and the 1990s have seen a notable shift in the use of environmental taxes and other market-based instruments (such as, tradable permits or deposit refunds) in addition to command and control instruments as measures of environmental policy. This can be attributed to the increased awareness of the power and potential of markets, a new orientation towards markets in public policy and increased recognition of the limitations of government in general, and of traditional command and control systems of environmental regulation in particular. Also, the relative ease of mobilising labour and capital and the increase in e-commerce enhances the attraction of fixed and material factors such as energy or land as tax bases (EEA, 2000).

The Kyoto Protocol (Grubb et al., 1999) was the most comprehensive of all environmental treaties. Developed countries now have legally binding targets to reduce greenhouse gas (GHG) emissions following their agreement in 1997 on the Kyoto Protocol to the United Nations Framework Convention to Climate Change. Overall, developed countries have agreed to reduce emissions of GHG to 5.2% below 1990 levels in the period 2008–2012. The EU has agreed a target reduction of 8% under the Protocol. This was shared out amongst member states, with the UK taking on a target reduction of 12.5%. The Government also has a domestic goal of

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[1] Trapping of the sun's radiation by clouds, water vapour and the GHGs carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halofluorocarbon (HFC), perfluorocarbon (PFC) and SF_6.

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reducing carbon dioxide (CO_2) emissions by 20% from 1990 levels by 2010[2].

The Department of Environment, Transport and the Regions (DETR, 2000, 2001)[3] launched its main consultation on a comprehensive greenhouse gas emissions reduction strategy for the UK (entitled the UK Climate Change Programme) in October 1998. This was closely followed by an announcement by the Chancellor in the March 1999 budget that a levy will be introduced on all business use of energy in 2001. The Climate Change Levy (CCL) will be a key instrument in the Government's package of measures to meet its Kyoto targets and to reduce CO_2 emissions in the UK. The levy should raise £1 billion in the first year. The levy should entail no overall increase in the burden of taxation on business as it will be accompanied by a 0.3% cut in employer national insurance contributions (NIC) and support for energy efficiency schemes and renewable energy sources. The levy came into affect on the 1st of April 2001.

The UK is by no means a novice in the field of pollution taxes. The government made a commitment in 1993, as part of its CO_2 reduction programme, to increase road fuel duties, then about 60% of the price of road fuels, by 5% per annum in real terms. The new Labour Government increased this to 6% per annum in 1997. The UK landfill tax was introduced at £7 per tonne for active waste and £2 per tonne for inert waste in October 1996 (Ekins, 1999). Apart from these a duty on hydrocarbon oils, fossil fuel levy, vehicle tax and air passenger duties are also administered. Environmental taxes as a percentage of total taxes and social contribution, and Gross Domestic Product accounted for 9.8 and 3.7, respectively.[4]

A number of countries in the OECD have imposed carbon/energy taxes on industries (OECD, 1989). By 1994, Denmark, The Netherlands, Norway, Finland and Sweden had in place a form of carbon/energy tax. With the exception of Finland the rest of them also conducted a limited green tax reform (EEA, 1996). Furthermore Belgium, Denmark, Finland, Sweden and Canada had set up official task forces or Commissions to investigate such reforms.

2. Overview of the levy

The basic design of the levy follows the recommendations made in Lord Marshall's report "Economic Instruments and the Business Use of Energy", published in October 1998.[5] The levy's main objective is to play a major role in helping the UK to meet its targets for reducing greenhouse gas emissions. It will entail no increase in the tax burden on industry as a whole and no net gain for the public finances. The reforms are intended to promote energy efficiency, encourage employment opportunities and stimulate investment in new technologies.

The Levy Rates[6] for 2001/2 (pence/kWh) will apply to:

Electricity	0.43
Gas	0.15
Coal	0.15
LPG	0.07

on their energy content[7], when supplied to commerce and industry for heating, lighting, motive power and power for appliances.

The Chancellor announced that the CCL would be charged on industrial and commercial use of energy. The design of the levy aims to achieve a balance between its environmental objectives and administrative simplicity. In doing so account has been taken of the structure of the energy industries, the need to minimise the compliance costs of businesses and the aim to protect the competitive position of UK industry, as well as the need to administer the specific reliefs and exemptions. Electricity and gas supply companies (including licensed suppliers), importers of energy for their own commercial/industrial consumption, energy producers using own produced energy and community heating schemes supplying surplus heat to industrial and commercial customers will be required to register and to account for and pay the levy. The levy will not be charged on domestic use of energy, energy used by public transport, energy from "new" renewables, energy in "good quality" combined heat and power (CHP) plants, traction electricity from rail-freight locomotives, energy products which serve a dual purpose as both feedstocks and fuel in the same process and electricity used in electrolysis in all processes similar to chlor-alkali production and primary aluminium smelting. There is a special exemption for horticulture in Budget 2000, a 50% relief for supplies for either heating the produce or lighting the produce or sterilising the earth. The relief is based on the acknowledgement that the horticulture sector is relatively energy-intensive and has a large

[2] ACBE Eighth Progress Report, p.10 (http://www.dti.gov.uk/acbe8/).

[3] Now known as Department for Environment, Food and Regional Affairs (DEFRA).

[4] UK National Statistics. http://www.statistics.gov.uk/themes/environment/articles/environmentalaccounts/envtaxes.asp.

[5] http://www.hm-treasury.gov.uk/pub/html/reg/consultation.pdf.

[6] The actual rate reflects the conversion factors of source energy into electricity.

[7] Electricity requires special rules, as considerable proportion of the energy content of fossil fuels used in electricity generation is lost in combustion, transmission and distribution. The rate to be applied to electricity is set such that it is equal to the amount of the levy which would have been charged had the inputs to generation been taxed on the basis of their energy content.

number of smaller companies and is exposed to significant international competition. To avoid double taxation (or indirectly taxing domestic or other relieved use), energy that is an input to the production of another energy product will not be subject to the levy. This would include for example, gas and coal used to generate electricity, coal used to make coke, electricity used for pumping water into high level reservoirs in pumped storage hydro-electric stations and energy used to crack crude oil in the oil refining process. Since the CCL is a downstream tax, the fact that energy may have been imported or produced in the UK will be irrelevant as all supplies of energy will attract the levy at the point at which they are supplied to the final industrial/commercial consumer.[8]

All firms regulated by the EU Integrated Pollution Prevention and Control Directive (IPPC) or are in sectors regulated by the IPPC, but which are themselves too small to be covered by the directive are eligible to sign negotiated agreements to avail an 80% discount on the levy. This is based on the condition that the firms will oblige to reduce energy use or increase energy efficiency over a 10-year period.

Quantitative targets have been derived at a sector level by negotiating the potential improvements that could be made in a cost-effective way compared with a base year. Targets may be absolute or relative. Absolute targets are energy use or carbon emission by a sector and relative targets are energy per unit output or carbon emissions per unit output.

To protect the competitiveness of UK firms of the £1 billion raised in revenues from the levy, the government will fully recycle it, principally through the 0.3% cut in the rate of employers' NICs amounting to £850 million. A further £50 million of revenue will be allocated to schemes to support energy efficiency and renewable energy. In addition, £100 million will be available in 2001/2002 for enhanced capital allowances (ECAs)[9] for investment in energy efficiency. This provides a strong and positive linkage between the levy and the environmental damage which it aims to control as it provides appropriate information for polluters to understand why the tax is being introduced and what are the alternative less polluting forms of consumption or production available. The ECAs scheme in the first year, for firms making energy saving investments is in line with established programmes operating in other countries, which aim to speed up technological innovation and to facilitate the diffusion of new technologies by developing synergies between Research and Development (R&D) and advice programmes. Synergy between the various elements is vital to enable the various policies and measures to work together. This builds on existing programmes, mainly the Energy Efficiency Best Practice Programme (EEBPP), to give the new CCL programme the essential momentum and confidence that some elements have been tried, tested and successfully applied. The EEBPP offers a service to businesses by closely integrating the various elements of the scheme to minimise the risk of businesses choosing an inappropriate element of the programme. Thus, for example, companies would have access to energy efficiency advice to identify and rank energy efficiency opportunities before entering into a programme of investment that may qualify for capital allowances.

In conjunction with the CCL, the emission trading scheme is being introduced to provide firms with added incentives and flexibility to reduce emissions and energy use. It follows from the Marshall report which recommended an initiative led by business to design an initial pilot phase of a domestic trading scheme for greenhouse gases. Following on this advice, the Confederation of British Industries (CBI) and the Advisory Committee on Business and the Environment (ACBE) set up the UK Emissions Trading Group in June 1999 to take forward the design of a UK scheme. The development of the scheme in the UK has primarily been taken forward by the business-led UK Emission Trading Group (ETG). If a facility meets its quantitative target, it can then claim a number of emission permits. It can then sell those permits to someone else in the same or another sector. It can also bank for future use or transfer the permits between its own portfolio of activities if it has more than one facility. Companies or facilities that fail to meet their targets through their own efforts may buy those emission permits from others. Firms which have signed climate change agreements, and have energy/emissions targets in order to receive an 80% CCL discount, can choose to trade to meet their targets through the trading scheme, thereby benefiting from extra flexibility and lower compliance costs.

3. Literature background and role of pollution taxes

In 1920 A.C. Pigou suggested the use of taxation to solve the problem of smog in London, which imposed a serious environmental dilemma. If the tax level is the difference between private marginal benefit of the polluter and the social marginal benefit at the optimum point, then this will be the efficient taxation level. The existence of such a uniform environmental tax means that firms will reduce emission up to the point where the marginal cost of reducing one extra pollution unit equals the tax rate.

However, the literature work on carbon/energy taxes has been more rhetoric in the last decade and a half. Most of the work undertaken till date indicates

[8] http://www.etsu.com/ccltexts/.
[9] http://www.eca.gov.uk/index.cfm.

negligible or positive effect on the GDP when the tax revenue is recycled back in the form incentives to invest in modern carbon abatement and energy efficient systems or cut in distortionary labour taxes (Pearce, 1991; Sandmo, 1975; Ekins, 1994, 1999; Jaeger, 1995; Ekins and Speck, 1999). Limited literature exists on the net benefits of pollution taxes, which may be highly underestimated, if the tax revenues are not used to lower other taxes (Sandmo, 1975; Pezzey, 1992).

Recent papers have acknowledged the seriousness of the issue and empirical studies do elucidate the drawbacks of energy/carbon taxes. Ekins and Speck (1999) have pointed that in a number of European countries the rate applied to energy-intensive industries is considerably less than that applied to other energy consumers which seriously undermines the effectiveness of carbon/energy taxes. The exemptions are justified on the grounds of competitiveness but increases the social cost of achieving an environmental target.

Ekins (1994) makes two important conclusions. Firstly, the tax should increase gradually; this tends to keep firms vigilant towards their energy use and speeds up the adoptions of new energy technologies. Secondly, to maintain revenue and fiscal neutrality other taxes (like labour, excise, and social security contributions) should be reduced.

The CCL has incorporated some of the insights—namely revenue-recycling mechanisms, incentives for development of carbon abatement and energy efficient technology—provided by the literature on energy taxes. However, the levy rates have been scaled down on two occasions amongst grievances from certain sectors (mainly the EEF, the UK Steel Association) on grounds of increased input costs and competitiveness losses.

4. Implications on competitiveness

Competitiveness basically denotes the ability of a national economy, or a productive sector, to sell its goods and services in domestic and world markets. The imposition of an energy tax significantly increases the overall costs. In this case, the prices of the firm's goods will rise, production will fall or its profits will decrease or all of them. The extra costs will impair the competitiveness of the firm concerned. A basis for measuring the impact of the CCL on competitiveness can be classified into the following categories.

Firstly, the CCL can cause changes in net exports of energy/carbon-intensive industries compared to producers under less regulated conditions. Firms in the region if losing domestic, Euro or world market share because of the CCL and emission trading to countries with less stringent regulations. Thus, the magnitude and significance of an econometric parameter estimate that captures the effect of regulatory stringency in a regression explaining changes in net exports and production across energy/carbon-intensive industries could be taken as an indicator of the strength of the effects of the levy (and emission trading) on competitiveness (Jaffe et al., 1995).

Second, if the two instruments cause firms' investment to drop in the region, then there should be relative increase in investment by these firms overseas or in less energy/carbon-intensive industries in the country. Thirdly, is the impact on productivity of industries. Productivity is defined as output per unit of inputs, so pollution abatement should reduce productivity, as changes in production function because the CCL will have to incorporate abatement capital. This will affect the amount or combination of conventional inputs necessary to produce the manufactured output (Barbera and McConnell, 1990). Increased abatement/energy expenditure will increase a plant's capital stock without increasing output; this will lead to a fall in total factor productivity (TFP) at the cost of an environmental good. TFP can be defined as growth in cost not accounted for by growth in prices and output. It can be calculated by the difference between output and the weighted average of three inputs, namely, labour, energy and non-energy expenditures and capital stock[10] (Gray and Ronald, 1994). TFP is thus affected as environmental investment may crowd out other investments by firms.

Compliance costs is another aspect, which will affect competitiveness. Compliance costs, which is the end of the line is easy to measure compared to completely redesigning the production process. It can be measured as the plant's average annual operating costs for pollution abatement divided by the plant's average value of shipments/production over some period. It should be calculated as the plant's annual operating cost for pollution abatement as current production is affected by the entire stock of existing pollution abatement capital not just current year's capital expenditures. Much of the industries' investment in pollution abatement capital has occurred before the CCL and ET, so we cannot attribute these costs to these regulations specifically. Another advantage of operating cost measure is that it includes depreciation and amortization of existing pollution abatement capital. To reduce compliance costs, the double-dividend feature (the reduction in NICs in the CCL programme) of the CCL programme asserts that, rather than assuming neutral lump sum redistribution (as the marginal cost will not be altered by a lump sum redistribution of revenues) back to consumers, the tax revenues derived from an eco-tax can be applied to a greater effect to reduce distortionary marginal taxes in the rest of the economy (Jackson, 2000). Even if the effect is small net

[10] $\mathrm{TFP} = \log(\mathrm{Y}) - a_{\mathrm{L}} \log(\mathrm{L}) - a_{\mathrm{M}} - \log(\mathrm{M}) - a_{\mathrm{K}} \log(\mathrm{K})$.

benefits from environmental taxation should be considerably enhanced. This has clear implications on competitiveness of firms as it may reduce their taxation burden and provide incentives for emission reduction and energy efficiency.

However, on the other hand, some authors based on empirical studies (Kalt, 1988; Jaffe et al., 1995) do not find significant impact on competitiveness based on changes in trade and investment patterns. Porter's (1991, 1995) argument supported by a large number of case studies is that properly designed environmental policies can stimulate innovation that may to a partial extent or fully offset the cost of compliance. It has also been shown that increase in production costs (due to an emissions tax) leads to an adjustment of the capital stock to increase average productivity (Xepapadeas and DeZeeuw, 1999).

The CCL by taxing energy use will send clear signals to energy-intensive users to switch fuels. This will cause significant changes in the energy markets, as the price of conventional sources of energy will rise with a corresponding fall in quantity demanded (Barker et al., 1995), taking the form of an income effect. On the other hand, the demand curve for renewable sources of energy and energy from CHP will shift to the right as they receive compensation or are exempt from the levy. This change in relative factor prices of renewable sources of energy and energy from CHP, taking the form of a substitution effect, will further reduce the demand for conventional sources of energy. Thus, if substitution effects and process innovation are taken into consideration, then the price effect induced by the energy tax will be less (or not overestimated).

5. Alternative responses to the levy to safeguard competitiveness

The impact of the CCL will be reflected on the firm's cost structure, and thus is a major factor affecting its competitiveness. A carbon/energy tax will imply an increase in costs, to which a firm may react in different ways, for instance by:

5.1. Tax incidence and shift analysis

A firm has an option of bearing a part of the tax imposed by the government and shifting a part of it to its consumers. For any tax, proportion paid by customers compared to that paid by the producer will depend upon the shape and elasticities of the demand and supply curves (Turner et al., 1994).

In Fig. 1, a levy t^* on energy consumption will raise the cost of the firm. The firm will supply the original quantity only if it receives the higher price $p_0 + t^*$. The supply curve shifts to S'. If the firm charges the high

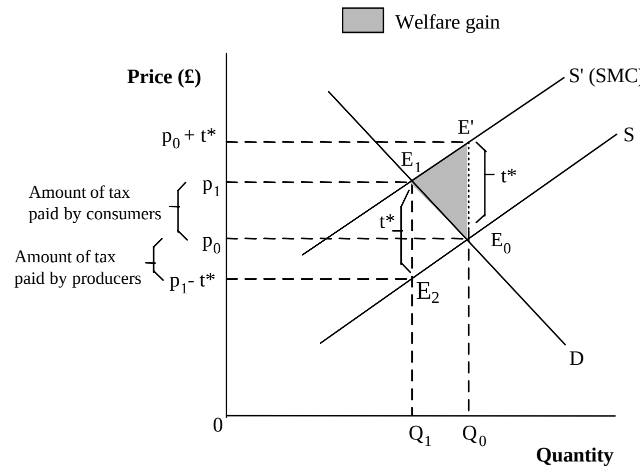

Fig. 1. Incidence and shift analysis of an energy tax (CCL).

price $p_0 + t^*$, then output demanded will fall considerably. Therefore, at the new equilibrium E_1, quantity demanded is Q_1 at price p_1. The price rises from p_0 to p_1 but the firm has to pay a tax t^*, and only receives the price $p_1 - t^*$. This is shifted to the consumers and they pay $p_1 - p_0$ of the tax. In the economic sense, the above effect also imposes a welfare gain ($E_1E'E_0$) since at Q_0, marginal social cost is greater than willingness to pay. Consumers lose benefits $E_0Q_0Q_1E_1$, total costs' fall by $E'Q_0Q_1E_1$ gives us net welfare gain $E_1E'E_0$. Standard microeconomics assumes that resources shift quickly elsewhere, therefore cost savings equal gain. However in real life, a number of agents like resource owners, workers, owners of capital and consumers are affected. Thus the imposition of the tax may induce a fall in demand, which will reduce the value of resources and owners of capital may find the rate of return of their investment falling. This in turn may result in a lower level of demand for labour (for capital and energy-intensive industries) and in higher unemployment or lower real wages. These losses may affect domestic or foreign producers (country not imposing the tax), or both.

Taking into consideration consumer preferences and income-substitution effects, consumers could still continue to consume the original amount of the product at the higher price, but only by cutting down consumption of other goods. This may also lead to a market distortion if consumers buy products from foreign suppliers assuming that the country from where the good is imported has no form of energy/carbon tax.

5.2. Meeting abatement and energy efficiency targets through output cuts or process changes

A firm may have undertaken extensive measures to improve its energy efficiency and carbon emission levels prior to the introduction of the levy, and hence will be

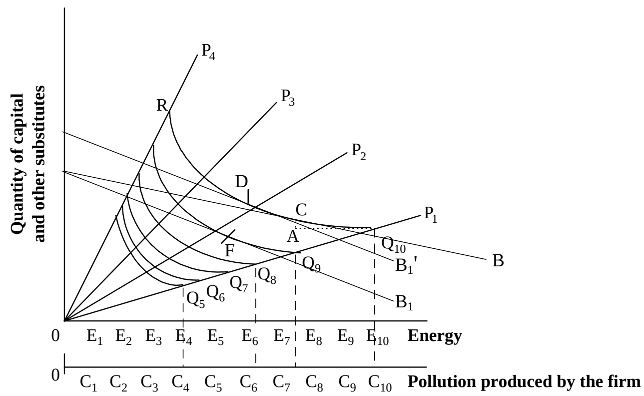

Fig. 2. Output cuts, process changes and abatement costs.

committed to a production process. This will definitely be the case in the short run and to reduce its tax liability the firm will only be able to meet its target by cutting output.[11]

On the other hand, a product is produced by using various factors like energy, labour and capital. Since the CCL makes energy expensive and labour cheap, energy can be substituted by other factors. A process change can be of two forms; a switch that reduces the quantity of pollutants emitted or a change in the form in which the pollutants are emitted. The former may involve recycling techniques or improving the material use efficiency of the plant, thereby reducing input demand and energy use by the plant. The latter refer to devices, which alter the composition of the gases at the point of exit.[12] Thermal oxidisers, electrolytic extractors and filters in chimney stacks convert the harmful gases into more compact solid which can be disposed of on land or water.[13] However, both the above process change methods may require large amounts of energy to function not withstanding the fact they reduce harmful gases and some emissions. We model the above stated scenario in Fig. 2. It is a static model for a single time period and assumes all things are constant *ceteris paribus*.

The y-axis shows capital and other substitutes[14] and the x-axis depicts energy-use levels. The rays represent the factor mix for producing each unit of output shown by the isoquants. For example P_1 is the most energy-intensive and polluting process at Q_{10} level of output. P_4 on the other hand substitutes energy with capital and other substitutes and is thus a less energy-intensive production process.

We assume a proportional relationship between energy use and pollution produced by the firm. Reducing output from Q_{10} to Q_9 results in considerable fall in energy use and the pollution produced by the firm also falls by a proportionate amount.[15] It is a stylised diagram and reducing output by equal increments lead to ever smaller incremental reduction in energy use. For example, further reduction in output from Q_9 to Q_8 becomes less successful in reducing energy use and pollution because of diminishing returns to factor and scale. Thus to achieve lower emission levels larger sacrifices of outputs and profits is required.[16]

On the other hand, the firm can reduce energy use (and pollution) and improve energy efficiency by adjusting its input mix. To achieve the same level of energy reduction as the output cut, the firm can move up the isoquant $Q_{10}R$. A near zero slope at $Q_{10}R$ indicates that the marginal cost of abating (MCA) through process change is minimal. The value is given by CA times the price of the substitutes (labour, capital, etc.). However, for further reduction in pollution and energy consumption the isoquant steepens, indicating an increasing difficulty of substituting energy.[17] Comparing the costs of both to achieve an emission and energy level target can be a decision factor to safeguard against the levy. Also, the iso-cost line B and B_1 indicates that the reduction in energy use and pollution due to the levy can be decomposed into a substitution effect (movement from C to D, substituting energy with other forms of input) and an income effect (movement from D to F, i.e. less demand for energy due to cuts in output).

However, in real case scenarios, reducing energy use may not result in a proportional decrease in the level of pollution. This aspect depends on the production process, how differently energy sources are processed, what type of abatement equipment is used and the different gases they are mitigating. For example coal used in a blast furnace fitted with fume extractors will reduce the level of pollution but not the energy use.

5.3. Relocation of production activities

This has serious implications for the environment as it just shifts the environmental damage elsewhere and no environmental gain takes place from the tax. A simple

[11] This analysis is taken from Paul Burrow's work, "The Economic Theory of Pollution Control", 1979, Chapter 2, pp. 7–50. Some modifications have been made to fit this study.

[12] Most of these devices do not reduce CO_2 and some in treating other pollutants will produce more CO_2. Insight provided by Dr. Tony Edwards, Environment Agency.

[13] This is an example of how solving an air pollution problem may result in a hazard to land or water instead. Insight provided by Dr. Tony Edwards, Environment Agency.

[14] Other substitutes refer to labour and for example taking electricity generated from CHP and renewable sources of energy.

[15] For example, 14,000 g of CO_2 is released by the consumption of one gigajoule of Natural Gas and 24,000 by the same amount of coal (http://www.dti.gov.uk/epa/annexb.pdf).

[16] Hence, the MAC curve through output cuts slopes upward right to left. Please see Fig. 3.

[17] Hence, the MAC curve through process shift rises from right to left. Diagram same as above endnote.

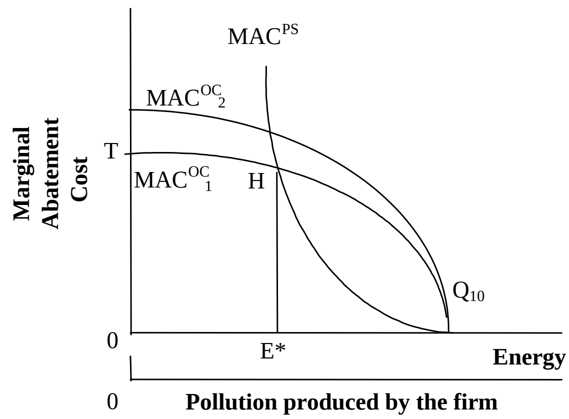

Fig. 3. Marginal abatement cost through output cuts or process changes.

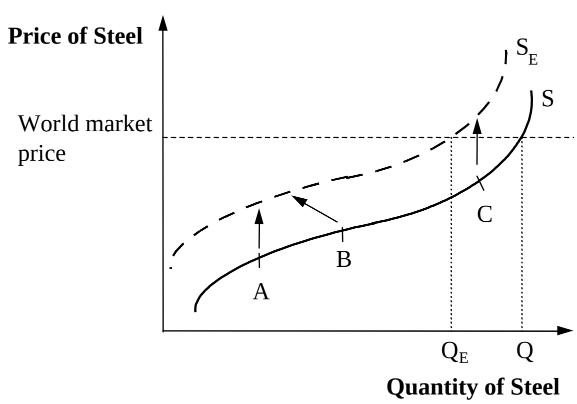

Fig. 4. Hypothetical effect of the levy on Corus.

illustration can explain the implications of relocating on competitiveness and the environment. Relocating is indeed a feasible option for Corus. Since it is formed as a merger of two companies (British Steel and Koninklijke Hoogovens) it is relatively easier to relocate part of its production and other energy-intensive activity in the Netherlands if it is penalised more than other competing economies. An analysis, which shows the change in relative competitiveness in the international market and a decision criterion for relocation, is given in Fig. 4.[18]

In Fig. 4, the impact of an energy tax on the steel sector is shown. The curve S is the industry supply curve before the tax is levied, and the dashed line S^E is this curve after the levy. If we assume A to be Corus's position, where the firm uses modern methods of production but using coal and natural gas as fuel and B another steel industry's position, where B obtains its energy from CHP plants and renewable sources of energy, then after the levy the competitive advantage of A is reduced relative to B and can even be lesser than B.[19] Another aspect, which is clear from the figure, is that the output of the industry will fall from Q to Q_E. For other industries located in countries like India and China, where world market price does not change (and thus demand), a relative cost advantage is obtained and the production is increased by an amount corresponding to QQ_E.

The case for relocation arises if Corus is in a position like C, where the introduction of the levy leaves it operating on the supply curve above the world market price. This will induce the firm to locate production outside the tax area (in this case the UK) or in a country where the supply curve does not shift out to the same extent (example Netherlands). Such a response would be related to an inability to reduce the energy-related costs in its production function and the resulting loss of market share and/or profitability vis-à-vis competing firms.

6. Implications of carbon/energy taxes and emission trading

Carbon/energy taxes and tradeable emission permits both work through the price incentive mechanism but have fundamentally different roles in achieving an environmental target. Taxes are used primarily to improve environmental quality by redistributing revenues, whereas permits are used mainly to promote cost savings and provide flexibility to firms in order to achieve an environmental target cost effectively. The cost effectiveness of the levy and the emission trading scheme depends on market-related features: the price elasticity or the availability of alternatives, the potential for technological innovation, the extent abatement costs might differ across sectors, the extent domestic sectors are in a favourable competitive position or in a fast growing market and the market structure itself (competitive or oligopolistic markets).

For the emission trading scheme and the CCL, defining which sectors should be covered, we need to consider environmental effectiveness, economic efficiency, the potential effects on competition, administrative feasibility and the possible existence of alternative policies and measures. For example, considering only six sectors in the EU covers approximately 45% of its CO_2 emissions (Green Paper, 2000).

The CCL may cause *inflation* (since it is an energy tax), as raising the price of fossil fuel will raise the general price level. This can be offset by reductions in Value Added Tax (VAT) or other taxes, which will tend to reduce the price level. In the presence of inflation, the

[18] Assumed to be an energy-intensive industry.

[19] As energy from CHP and renewables are exempt from the levy or receive concessions.

tax rate may lose some of its real value over time, if it is not indexed. In theory, if taxes are reduced in other parts of the economy then the inflationary effects of an energy tax can be compensated (Ekins, 1994; Jaeger, 1995; Sandmo, 1975).

The most debatable of all the issues is the *variation in factor prices*[20] caused by the imposition of the levy. If energy and capital are complements, then increasing the price of energy will reduce the demand in production for both energy and capital, thereby reducing both investment and growth. A second cost is verified by Jorgenson's work (Jorgenson, 1990). The results of his empirical work in this area have shown that, in thirty-two out of thirty-five sectors studied, productivity growth had an energy-using bias, which would mean that, in these sectors, increasing the price of energy would reduce productivity growth. On the other hand this will provide an impetus to energy saving and energy efficient investment and a continuously increasing energy price will provide continuously increasing incentive.

It is very difficult for any government to achieve *revenue neutrality*. The CCL does achieve it to some extent through the NICs. However, the levy has to make allowance that labour-intensive sectors such as banking and the public sector are also encouraged to focus on energy efficiency. The current levy design still leaves some sectors as net beneficiaries and it seems unlikely that where energy bills remain a relatively small proportion of costs, management time will be properly focused on improving efficiency. Moreover, in the UK, the Engineer's Employer's federation (EEF) have been actively voicing their concern since the inception of the levy. In the first 3 months of the levy, engineering firms within the EEF are paying 17% of revenue raised by the levy, well above its 8% share of the economy.[21] Even if the package is revenue neutral in its inception, it can still impose a burden on the economy as it leads to firms having to undertake investments, which would not have been required under a "business-as-usual" condition (Weidsacker and Jochen, 1992). The Confederation of British Industries (CBI) on the context of revenue neutrality have proposed that the £50 million energy efficiency fund should be made fully available to the benefit of business payers of the CCL.[22] The government has set aside £33 million from the fund to encourage energy efficiency investment in the SME sector and the remaining £17 m towards the development renewable energy sources (which would benefit others than just CCL payers).

The *price inelasticity of energy demand* makes the wrong tax rate an excessive risk and taxation a very blunt instrument, which can have undesirable results. The Government, by reducing the CCL rates in the Pre-Budget report has reduced the risk, but there is a need to keep the rates under review if competitiveness adversely affects the British industry. From an economic perspective this aspect is important as the long-term nature of the environmental consequences of global warming, as well as policies designed to mitigate such warming, estimates of very-long-term energy elasticities (i.e. periods of more than 20 years) are clearly of more relevance than estimates of short-term energy elasticities. The Energy-intensive Users Group (EIUG) has criticised the preparatory work on the levy as there has been no analysis of the price elasticity of demand and thus of the potential impact of the proposed tax rate. However, most empirical studies of energy demand have focussed on elasticities estimated on data usually covering 20–30 year periods. This is because the objectives of the research have not usually extended to issues involving time frames such as those required for the analysis of global warming and the data for longer periods are either unavailable or unreliable (Barker et al., 1995). This imposes an information burden on the regulator and to engage in an iterative trial and error process over time to find the optimal tax rate. On the other hand, emission trading does not face this problem as the price is determined by the firms trading in the market and not the control authority.[23]

With the CCL the effects on competitiveness would only arise if environmental policy in different countries impose different levels of costs on competing firms. However, in practice environmental policy and the regulations to which it gives rise are not harmonised between countries (although such harmonisation is more apparent in countries like in the European Union). This is one of the major reasons, which adversely affects competitiveness (and a cause for leakages). For example, the chemical sector in the UK faces competition with the other countries in the EU, the US and Japan, as they are the largest producers of chemicals in the world, together accounting for 71% of the world's production.[24] These countries have strong environmental policies and Kyoto commitments. On the other hand, 40% of world steel is produced in countries that have no Kyoto commitments[25] and the UK steel industry faces competition with countries (India and China) that are embarking on the road of economic growth with lenient environmental

[20] As the design of the levy essentially makes labour cheap and energy expensive through the revenue recycling scheme.

[21] http://www.eef.org.uk/fed/fednews/fedpressrel/fedpressrel.htm.

[22] http://www.cbi.org.uk/home.html—Official response: CBI Comments on the Climate Change Levy—October 2000.

[23] See Tietenberg (2000) for a more detailed explanation of this point.

[24] http://www.cefic.be/activities/eco/ff99 (taking Australia, Canada and New Zealand into consideration this figure will be significantly higher, and they all have strong environmental policies).

[25] http://www.uksteel.org.uk/ (CCL: Text of a parliamentary Briefing issued on 25th May, 1999.)

policies. Trading countries that do not have any energy or carbon emission reduction obligation leads to an unlevel playing field and is one of the main reasons that may affect competitiveness of British industries as a result of the CCL.

On theoretical grounds when considering the overall impact of the levy the double dividend feature of the CCL programme works only under a partial equilibrium analysis. Higher energy taxes lower energy consumption, which may yield environmental benefits. Lower labour taxes funded by the energy tax revenue lead to either lower wage costs for employers or higher after-tax wages for employees, thereby reducing unemployment. However, in a general equilibrium setting, both the regulatory effect (reducing emissions) and the revenue-raising effect (which allows lowering labour taxes) of the energy tax is included. This setting also allows for critical interactions between the energy and labour markets. In one interaction, higher energy costs lead businesses to lower energy inputs into production, which implies that labour productivity declines. This decline can lead to a lower wage rate being offered or a lower demand for labour by businesses. This is a probable scenario for energy and capital-intensive industries, and lowering NICs will not benefit them as their production function requires less labour inputs. This is backed up by the fact that the engineering sector estimates its gross costs with the imposition of the levy to well exceed £200 million and even after taking into account the national insurance reductions is still likely to exceed £100 million.[26]

7. The current situation

The levy along with the negotiated agreements is designed to save around 2 million tonnes of carbon a year by 2010. A recent estimate by the DEFRA based on figures from the Energy Technology and Support Unit (ETSU) and Building Research Establishment (BRE) showed that there is scope for carbon emission reduction, around 15–20% for most business sectors. However, on the competitiveness of firms it is imposing a burden on the manufacturing sector at a time when it is already in recession. A report published by the EEF carried out by Oxford Economic Forecasting (OEF) proposed that the government would achieve a greater reduction in energy use by scaling down the size of the levy, abolishing national insurance reduction and channeling all the revenue raised into increased incentives to invest in energy-saving equipment and technology. The ECAs (£100 m) programme for energy-saving projects, which is an important scheme to reduce competitive losses, has extremely restrictive eligibility criteria[27] and thus provides only limited incentive to firms to save energy. The Government restriction of allowing CCL agreements (like the 80% rebate) only to companies under IPPC coverage does not necessarily capture all energy-intensive processes within the agreements. For example, the industrial gases industry operates large air separation plants across the UK, using about 3 billion kWh of electricity per year (over 1% of total UK consumption).[28] Despite significant investment in energy efficiency in recent years, the effect of the CCL proposals will leave the industry facing an increased tax bill of around £13 million in the first 12 months, with rebates on NICs of around £500,000 per annum.[29] By limiting negotiated agreements to IPPC, the cost to the industrial gas industry is expected to create an unfair playing field with competitors in other Member states, which are already exempt from energy taxes. Also, a preliminary estimate provided by the DTI Energy Statistics implies that the levy might add 0.9% to the input (materials and fuels) index in October 2001.[30]

On the bright side 44 negotiated Climate Change Agreements (CCA) have been signed so far, which according to the ETSU will save 2.5 mtC by 2010[31] and would also offer firms the benefit of the 80% rebate on the levy. The UK is also thinking in terms of first mover advantage by investing in renewable energy technology and exploiting its offshore potential of harnessing wind energy. A number of case studies and assessment plans are being undertaken by firms to offset the cost of the levy by using renewable energy.[32] Since February 2000, the exemption from the CCL has been one of the main strands of UK's renewable energy policy. The aim is to increase the contribution of electricity from renewables in the UK to 5% by the end of 2003, rising to 10% in 2010, subject to the costs to consumers being acceptable.[33] Hence already the levy is providing a positive stimulus in the desired direction of developing renewable energy and increasing energy efficiency.

8. Conclusion

The design of UK's CCL is bound to leave some as winners and other losers compared to a business-as-usual scenario. The programme follows from studies,

[26] http://www.eef.org.uk/fed/fednews/fedpressrel/fedpressrel.htm.

[27] ECAs are only to be available to six technology categories on the UK list of technologies.

[28] http://www.bcga.co.uk/main.htm.

[29] http://www.cbi.org.uk/home.html—CCL issues to be resolved.

[30] http://www.statistics.gov.uk/themes/economy/articles/pricesandinflation/downloads/specimen_new_design_first_release.pdf.

[31] http://endsreport.com/issue/print.cfm?ArticleID = 7322.

[32] Market Transformation Programme http://www.mtprog.com/glancefram.html.

[33] Department of Trade and Industry http://www.dti.gov.uk/epa/digest01/07.pdf.

which have considered such economic instruments to stimulate technical change and impel energy efficiency and carbon abatement innovation (Porter and van der Linde, 1995; Tietenberg, 1985; Nentjes and Wiersma, 1988; Schneider and Goulder, 1999).

The levy is not even a year old, hence it is difficult to state in a concrete manner whether there are any significant ancillary benefits in the UK. However, certain desired signals have been picked up by industries, who are queuing to sign negotiated agreements or investing in energy efficient and carbon abatement projects. The most obvious ancillary benefit of the levy is the impetus provided to the renewable energy industry, as last year there was a 13% increase in the use of renewable sources of energy. The competitive losses quoted so far may be significantly reduced with the Emission Trading scheme coming into effect from the 1st of April 2002.

Both the instruments have their respective strengths and weaknesses. Thus to fulfil its emission reduction commitments a country should adopt a mix of both the instruments in order to maintain cost effectiveness and flexibility. Emission trading could rather cover emissions related to the production of goods in sectors (e.g. steel, chemical, refining) that are exposed to keen international competition (e.g. Corus). In this aspect, GHG emission trading is more likely to be used (than energy/carbon taxes) by private companies throughout the world, especially in the US, thereby minimising possible negative effects on international competitiveness. On the other hand, additional energy taxes could be focussed more on smaller or mobile sources whose emissions are difficult or expensive to monitor. Energy taxes could also be concentrated on emissions related to "non-process costs", such as space heating for industrial and commercial use, that is not exposed to the same pressures of international competition.

Recent empirical studies[34] indicate that competitive losses are insignificant; however, this is not going to be the case in the future. This is primarily because of three reasons. Firstly, past environmental policies have not resulted in an attenuation of environmental concern and the new goal of sustainable development seems to be requiring more stringent policy, with more potential effects on competitiveness, than in the past. Secondly, there is widespread agreement that in today's global economy "ever fiercer competition prevails" (HMSO, 1993) which raises the possibility that environmental regulations could be more of a competitive disadvantage than before. Finally, with the recent trend it seems likely that environmental policy in the future will make more use of environmental taxes and emission trading than in the past. Hence, environmental taxes like the CCL and the trading programme will have distinctive implications for competitiveness.

If energy efficiency could be increased at the same rate as the price of energy, then any negative effect of a rising energy price on costs would be cancelled out. There would be a positive stimulus with regard to the development of non-fossil energy technologies (Ekins and Speck, 1999). The only way energy-saving and carbon abatement technologies or alternative fuel technologies are developed is by an energy price increase[35]. The CCL is a part of UK's Climate Change Programme to bring about this spur, however, on its own it is not the ideal instrument to achieve it. A comprehensive package with transparency between the government and the firm along with negotiations between them is vital for maintaining industry competitiveness and achieving the desired environmental target.

The benefits from investing in carbon abatement technologies may not be quantifiable or substantial, but taking the risks from climate change into account simply reinforces the CCL's and the emission trading's economic rationality. It remains to be seen whether this rationality can be a major factor for policy makers to overcome the resistance of the energy-intensive industries and provide them with a comprehensive long-term environmental policy reform which does not impair their competitiveness.

[34] "The trade and investment impact which have been measured empirically are almost negligible" (OECD, 1996, p. 45).

[35] Grubb, 2000, "Asymmetrical price elasticities of energy demand" in Barker et al. (1995, pp. 307–308).

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