Implementation of the EC Directive on Packaging and Packaging Waste and Implications for the Environmental Performance and Competitiveness of Firms along the Food Industry Supply Chain

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Abstract

The EU Packaging Directive sets targets of 50-65% recovery and 25-45% recycling of all packaging and a minimum of 15% recycling of each packaging material by mid 2001. Each country has been left to implement its own regime. The main focus of this study is on the impact of the regulation of packaging and other solid waste on the environmental and competitive performance of firms along a supply chain. The effects of regulation are represented by sampling firms in Germany where stringent regulation has meant that German waste practice is well above that required by EU standards. Packaging initiatives and other waste management initiatives and costs incurred by firms in Germany are contrasted with those of similar (matched) firms in the Republic of Ireland and the UK where packaging regulations at the time of the study were just being introduced. In order to consider the impact of packaging waste regulatory pressures on an entire supply chain, food processors (more particularly, dairying and soft drinks and mineral water producers), food retailers and packaging manufacturers were selected as case studies in each country. The findings indicate that in Germany, strong regulatory requirements and external pressures along the supply chain were important drivers of company environmental behaviour. There was little evidence of regulation leading to a competitive disadvantage. At the micro level there was some evidence of competitiveness benefits arising from regulation and external pressures but these advantages were not evident at the firm level. The study extends earlier work by the authors' (Hitchens et al, 1998a,1998b) on the competitiveness effects of the regulation of effluent waste.

Aims and method[1]

The central aim of this study was to measure the impact of regulation with respect to packaging waste on the competitiveness and environmental performance of firms across the EU. An important and innovative component of the study was its emphasis on backward and forward linkages. The samples considered an entire supply chain: packaging suppliers, food processors (more particularly, dairying and soft drinks and mineral waters) and the food retail sector.

The competitiveness effects of regulation were represented by sampling firms in Germany where the Packaging Ordinance, enacted since 1991, has meant that German waste practice is well above that required by EU standards. Packaging initiatives and other waste management initiatives and costs incurred by firms in Germany are contrasted with those of similar (matched) firms in Ireland, the UK and Ireland where packaging regulations at the time of the study were just being

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introduced (Packaging Legislation in the study areas is described in more detail in Appendix 1).

European policy aims

The EU Directive on Packaging and Packaging Waste (1994) was driven by a number of factors including the decreased availability of land suitable for landfill sites, and the growing concern about increasing packaging waste from both domestic and industrial sources. The main aim of the Directive was to limit the use of landfill by increasing the quantities being recycled and re-used. Solutions to the disposal problems include attempts to reduce the volume of waste for disposal, through *waste minimisation strategies,* as well as the encouragement to recycle and reuse items which might otherwise become waste. The Directive has set targets to be achieved by 30 June 2001. Thereafter the targets are to be revised every five years. The EU Directive states that:

by 31 December 2001, recovery of a minimum of 50 per cent and a maximum of 65 per cent by weight of all packaging waste with such recovery including:-

(1.) recycling of 25-45 per cent of packaging waste, and
(2.) recycling of a minimum of 15 per cent of packaging waste from each individual packaging material.

Individual countries are at liberty to attain recycling and recovery rates in excess of these rates provided that their own packaging industries are capable of fully absorbing such an amount of recycled materials. The EU was anxious to avoid recycled material from one EU country being dumped on to another with the possible result that the recycling industry in the second country would be stifled. In the context of this study it is worth stressing that the Republic of Ireland as well as the other three Cohesion countries, i.e. Portugal, Spain and Greece, gained a derogation from the provisions of this Directive such that they have until 2005 to attain the target levels outlined above.

The effects of regulation on competitiveness

There are a number of factors that are important. In general terms a negative impact on the output and employment of firms will be larger the greater the rise in costs following compliance; the greater the differential cost penalty relative to domestic and foreign competitors; the more significant the costs are in total costs; the greater the degree of price competition between firms and the greater the sensitivity of demand to price increases (OECD,1993). On the other regulation may stimulate innovation and raise productivity. Michael Porter (Porter, 1990,1991) hypothesises that innovation takes place in response to regulation and leads to *innovation offsets.* He notes that in Germany tough legislation and stringent recycling targets for packaging materials has led to significant pressures to bring about changes in packaging materials, including lightweighting, and widespread use of reusable, recoverable and recyclable materials, *'German firms had an early mover advantage in developing less packaging intensive products, which have been warmly received in the market place'* (Porter and van der Linde, 1995).

Previous studies of the link between regulation and company competitiveness

Consideration of the extensive literature on the environmental regulation-competitiveness interaction in the US (heretofore there has been much less research in Europe) suggests that regulations have had only limited impacts on industrial performance (e.g. with respect to levels of investment, or its location, or the rate of growth of productivity; Kalt, 1988; Grossman and Krueger, 1993; Jaffe, Peterson, Portney and Stavins, 1995). Jaffe, Peterson, Portney and Stavins (1995) concluded "... there is relatively little evidence to support the hypothesis that environmental regulations have had a large adverse effect on competitiveness". Or, as Porter and van der Linde (1995) put it, "... it is striking that so many studies find that even the poorly designed environmental laws presently in effect have little adverse effect on competitiveness".

Sample industries

Dairy and Drinks Industries

The dairy processing and the soft drinks and mineral water industries were chosen as industries sensitive to packaging regulations within the food processing sector. As far as the dairy processing industry is concerned, some of the biggest problems stem from the disposal of packaging and the recycling of a wide range of used containers. In 1995 the German dairy industry contributed DM 750 m., almost a fifth, to the licence fees of the *Duales System Deutschland AG*. Hülsemeyer (1997) argues that this additional costs reduces competitiveness of the industry, since 1 kg. of raw milk is on average burdened by about 4 Pf. in Germany in contrast to less than 2 Pf. in Belgium and Austria and no payments, as of yet, for recycling in Denmark, Spain, the Netherlands, Italy, UK and France.

In soft drinks, the most heavily used packaging type in the EU is non-returnable plastic. This is especially the case in the Republic of Ireland and the UK while in Germany reusable bottles account for nearly ninety percent of packaging of mineral water and soft drinks[2]. Metal packaging accounts for a modest share and is most popular in the UK. Non-returnable glass accounts for about 10 per cent of the packaging used for soft drinks in Germany and 6 and 2 per cent respectively in the Republic of Ireland and UK.

Packaging materials

Regulation influences the packaging materials industries. For example it is relatively easy to recycle some metals, notably tinplate and aluminium. Fairly high rates of recycling have already been achieved for paper and board and glass has one of the highest rates of recycling of any industrial activity. Plastics present more of a problem. Material substitution is limited by the economic and technical characteristics of the different packaging materials and there are limits to the technical improvement of

[2] In terms of packaging 89.03 per cent of all mineral water was filled in reusable containers in 1995 (38.21 per cent of uncarbonated beverages and 75.29 per cent of carbonated beverages). On the average of all beverages 72.16 per cent were bottled in reusable containers, fulfilling the national quota of 72 per cent for all beverages except milk.

individual materials e.g. reduction in packaging weight. In addition, the choice of the packaging material is strongly influenced by the different functions which the packaging has to fulfil (e.g. protection against light, meeting of regulations, convenience, advertising aspects, etc.). In the food industries, the use of materials both in terms of quantities and types is influenced by the various technical problems arising in food containers and the requirement to package food safely. For example, the requirement to preserve freshness as well as exclude contamination and vapours (aluminium and glass perform better in these respects than most forms of plastic), or the need to hold carbonated drinks (plastics other than PET cannot do this). Table 1 summarises (for Germany) the economic, environmental and technical characteristics of packaging materials.

Food retailers

Pressures for environmental improvements arising from market sources are represented in the study by the food retail firms. The distribution industry can be divided into retail and wholesale distribution, with wholesaling referring to the resale of goods to retailers and other wholesalers or to manufacturers for further processing, while retailing is defined as the distribution of goods to the final consumer. The distribution industry within the EU is exhibiting increasing levels of concentration, a phenomenon more evident in northern member states than in the south where there remain a large number of independent enterprises (Commission of the European Communities, 1994). It is notable that Germany has several extremely large food retailing chains and in general the German food companies are larger than the main grocery companies in the UK. In the Republic of Ireland even the largest firms are small by European standards. The German and Great Britain retailers are likely to have monopsony positions relative to suppliers.

Table 1 Characteristics of Materials

Material	Economic Characteristics*)	Environmental Characteristics	Technical Characteristics
Packaging Paper	Paper industry holds the top position within the whole packaging industry: • 38.7 % of all packaging material, • 15.2 % of total industry turnover.	1 t of used paper helps to save 5m^3 of wood; price must cover costs of collecting, sorting, transport, but must also be competitive! required recycling quota in the Packaging Ordinance (since 1.7.1995): 64 % (actual recycling in 1993: 55 %)	low quality paper: no protection against moisture or heat, not very watertight; high quality paper: watertight, fat resistant; coated paper (by wax or paper): improves quality
Cartons			see above; coatings improve technical characterisitcs
Fibreboard			depends on weight and quality of paper
Plastics	Position 2 within the packaging industry: • 28.7 % of all packaging material, • 11.2 % of total industry turnover.	plastics must be cleaned and sorted before recycling; required recycling quota: 64 % (actual recycling in 1993: 29 %)	variety of different plastics; main common characteristics: light, easily malleable, resistant, good use for compounds
Aluminium	Metal industry holds position 3 within the packaging industry: • 22.7 % of all packaging, • 8.9 % of turnover; • aluminium is used much less in Europe than in US, • economic advantages of tinplate: ® stable steel price relative to aluminium, ® tinplate can be produced in very thin layers.	recycling needs only 5% of the energy needed for aluminium production from bauxite; 100% recycling possible; high scrap value of aluminium has made secondary aluminium production as large as primary one; since tinplate is magnetic, it can relatively easily be separated from other metal waste; but: downcycling; required recycling quota for aluminium and tinplate: 72 % (actual recycling of aluminium in 1993: 7 % through DSD; a lot of aluminium is also collected outside the DSD systems e.g. when fillers collect lids; recycling of tinplate in 1993: 35 %)	main disadvantage: cannot be produced as thinly as tinplate
Tinplate			tight, easily malleable, can easily be printed on
Glass	Position 4 within the packaging industry: • 6.6 % of all packaging, • 2.6 % of total industry turnover, • innovation: light glass bottle.	glass recyling saves costs and energy; secures market position against competitiors; required recycling quota: 72 % (actual recycling in 1993: 62 %)	resistant against almost all materials, neutral in taste and odour, transparent, tight
Wood	Position 5 within packaging industry: • 3.2 % of all packaging, • 1.2 % of total industry turnover.	recycling of valuable resources; no recycling quota	packaging mainly made from conifers; quality of packaging depends on moisture, weight, stability of raw material

Note: *): Data refer to 1990; only West Germany.. Sources: Bojkow (1989), Sprenger et al (1996), Klöckner (1992).

The hypotheses which were tested

The study uses a matched pairs comparison of companies to test the following key hypotheses:

(i.) *Response of individual firms and industries to different levels of regulation*
It was hypothesised that more stringent regulation will lead to a greater number of environmental initiatives undertaken by the firm both to comply with regulation and to minimise compliance costs.

(ii.) *Influence of the supply chain*
Market pressures and backward and forward linkages were hypothesised to give rise to further pressures for environmental initiatives to be undertaken by firms both for reasons of concern by consumers and because of regulation. While packaging requirements are influenced by a range of factors (the technical characteristics of the various material types, regulation, demand pressures and economic factors) concern on the part of consumers regarding green issues, product type, material usage and recycling and the impact of regulation will give rise to pressures from retailers[3], and pressures from major European retailers may be crucial in shaping the competitive advantage and environmental performance of certain food processors and packaging suppliers. The environmental response up and down the supply chain will also be an important influence on the efficient response by firms, while monopoly and monopsony power along the supply chain will affect who has the greatest control over the environmental standards.

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[3] This hypothesis captures a number of different possible relationships and mechanisms. Meffert and Kirchgeorg (1992) have suggested three basic strategies by which retailers can take environmental aspects into consideration:

(i). A first group of retailers, in particular discounters, are defensive with regard to environmental protection measures. Their basic concern is cost-orientation.

(ii). A second group of retailers could be described as undertaking environmental actions on a case-by-case basis; i.e. firms do not try to establish an overall environmental plan.

(iii). Other retailers follow a basic active environmental strategy and strive to gain competitive advantages by integrating environmental aspects into their management.

If both producers and retailers comprehend environmental management as a chance to gain competitive advantages, this can often trigger innovation throughout the vertical chain. Subsequently cooperations will be established with suppliers, the packaging industry, consumer and environmental associations.

In regard to their product assortment retailers can influence producers in several ways ("ecology-pull-strategy"):

- conscious selection of suppliers so as to favour those with the best environmental records,
- influence on suppliers in regard to product design and characteristics e.g. via directives on the selection of material use.

In the light of an increasing concentration and cooperation process in the retail sector there is a vertical integration which is connected with a growing influence on the production side. The effectiveness of an ecology-pull-strategy is largely determined by the relative power of retailers; retail demand power vs. strong trade marks of producers. Important decisions are taken in the negotiations between the big retailers and producers. The possibilities of influence for SMEs are limited. The increasing orientation of the big producers towards the European market strengthens the problem.

Retailers can also influence consumers by using an "ecology-push-strategy", e.g.:

- environmentally friendly product assortment,
- information services for consumers,
- deposit refund systems.

(iii.) *Influence of regulation and external pressures on the competitiveness of firms and plants*

Compliance can effect productivity and competitiveness either positively or negatively. Regulation can place firms at a competitive disadvantage and lead to the loss of markets particularly to countries with less stringent regulation. On the other hand, high standards and strict enforcement, can push firms on to a higher growth path by forcing them to make product and process changes which yield higher competitiveness.

Sample data

Sampling was based on three criteria (i). to broadly represent each of the sample industries in each country, (ii). to include principal firms in each industry (iii). to sample firms which could be matched internationally. Table 2 gives an industry and regional breakdown of firms sampled. Fifteen firms were sampled in N. Ireland and 20 in the Republic of Ireland. The majority of processing firms were located in Ireland while packaging suppliers and retail customers were located in both Ireland and Great Britain. Hence the twenty-two firms sampled in Great Britain represented, in the main, the major British supermarket retail customers and packaging suppliers used by the processing firms. In Germany a total of 57 interviews were made, sufficiently detailed responses for later analyses were available from 54 firms and plants. Interviews across the three sectors (retailing, processing and packaging), predominated in west Germany. In East Germany face-to-face interviews were conducted in Thuringia, Saxony, Saxony-Anhalt and Brandenburg. Since no indigenous retail chain is left in East Germany, only West German headquarters of the large supermarket chains were visited. Interviews in West Germany took place in Baden-Württemberg, Bavaria, Berlin, Hamburg, Lower Saxony, North-Rhine Westphalia and Rhineland Palatinate for firms from all sectors. Micro data were derived from the completion of detailed questionnaires during face to face interviews with senior managers. All data relate to the plant (in a few cases services were provided from another site or office, e.g. R&D, and such relevant data were included). In a number of cases head offices were interviewed and typical plant data obtained.

Table 2. Number and Geographical Distribution of Plants Sampled in UK & Ireland

	Northern Ireland	Republic of Ireland	Great Britain	Total
Total	**15**	**20**	**22**	**57**
Dairy	3	6	1	10
Soft Drinks	3	1	2	6
Retail	4	3	4	11
Packaging (total)	**5**	**10**	**15**	**30**
Plastics	4	1	3	8
Metals	-	-	5	5
Glass	-	1	2	3
Composites	-	-	1	1
Machinery	-	-	3	3
Paper and board	1	8	1	10

Study findings

(A) Environmental Performance

(i.) *Response of individual firms and industries to different levels of regulation*

Firms were asked for a detailed description of all solid waste initiatives undertaken. These were classified into *packaging reduction,* which encompasses lightweighting, pack sizing and innovative design, *packaging reuse* which involves a number of trips being made by the same package and *recycling* which covers the transformation of packaging into a new primary or secondary market product. *Packaging recovery* is often used to mean the conversion of used packaging into some secondary product or energy conversion as opposed to recycling. *Recovery*, in this study, has been used to describe the active collection of waste to recycle e.g. collection of scrap material or the placing of bottle/can banks on the premises.

In addition to these broad areas we have also classified measures which may reduce landfill or aid alternative methods of disposal. These include the *segregation of waste* (thus easing recycling), the *setting of waste targets* and the *reduction of waste volume* through the use of compactors and bailers.

Table 3 summarises the percentage of firms in each country undertaking different solid waste initiatives with detail shown for each sector. Overall in the Ireland/UK sample 256 solid waste initiatives were identified or 4.7 per firm and in Germany 480 initiatives or 8.9 per firm.

In both countries the most important initiatives were packaging reuse and recycling. Lightweighting and waste reduction were also significant in the Republic of Ireland/UK, and packaging recovery, lightweighting, packaging reduction and waste segregation in Germany.

In comparison with the Republic of Ireland/UK a greater percentage of German firms are engaged in waste initiatives for eight of the ten types of initiative shown. The exceptions are waste targeting and waste reduction (through the use of bailers and compactors) although the level of activity is broadly similar for lightweighting, waste reduction and packaging reduction. Looked at on a sectoral basis more German firms undertake initiatives in the majority of sub sections given (eight out of ten in retailing,

nine out of ten in packaging and half the number of subsectors in the dairy/drink sector).

Table 3
Solid waste initiatives by sector: number of initiatives and percent of companies

(a). IRELAND/UK

Initiative Description	Inits	% of All Companies	Inits	% of Dairy/Drink companies	Inits	% of Retail companies	Inits	% of Packaging companies
Reuse Materials	57	75%	23	94%	15	89%	19	60%
Recycle Materials	59	71%	17	69%	10	67%	32	73%
Special Design	3	5%	3	19%	0	0%	0	0%
Material Switching	7	13%	4	25%	2	22%	1	3%
Packaging Recovery	19	20%	1	6%	15	78%	3	10%
Lightweighting	34	58%	14	81%	0	0%	20	63%
Packaging Reduction	17	24%	10	38%	4	56%	3	7%
Waste Reduction	31	47%	10	50%	8	89%	13	33%
Waste Segregation	11	20%	6	38%	2	22%	3	10%
Waste Targeting	18	33%	8	50%	5	56%	5	17%
TOTAL	**256**		**96**		**61**		**99**	
Initiatives per firm		4.7		6.0		6.8		3.3

(b). GERMANY

Initiative Description	Inits	% of All Companies	Inits	% of Dairy/Drink companies	Inits	% of Retail companies	Inits	% of Packaging companies
Reuse Materials	113	89%	33	93%	31	100%	49	83%
Recycle Materials	134	96%	27	93%	34	100%	73	97%
Special Design	11	20%	2	13%	6	60%	3	10%
Material Switching	15	28%	5	33%	3	30%	7	24%
Packaging Recovery	63	98%	14	93%	20	100%	29	100%
Lightweighting	37	59%	6	40%	3	30%	28	79%
Packaging Reduction	33	24%	6	33%	21	60%	6	7%
Waste Reduction	25	46%	5	33%	7	70%	13	45%
Waste Segregation	44	81%	12	80%	8	80%	24	83%
Waste Targeting	5	9%	2	13%	3	30%	0	0%
TOTAL	**480**		**112**		**136**		**232**	
Initiatives per firm		8.9		7.5		13.6		8.0

It is noteworthy that in four areas, especially, there is more activity undertaken by German firms. This is in packaging design (particularly for retail and packaging companies), material switching, especially important for packaging companies, packaging recovery is more important across all sectors and waste segregation is particularly important across all sectors compared with Ireland. These activities are strongly driven by regulation

(ii.) *Influence of the supply chain*

Drivers for undertaking initiatives

Table 4 shows the main drivers for waste initiatives reported. The most important driver in each country was cost followed by legislation and customer/supplier pressure. In Germany legislation is responsible for significantly more initiatives than in the Republic of Ireland/UK samples, customer/supplier pressure is also relatively more important, itself often driven by regulation. Other drivers are relatively unimportant. The miscellaneous category includes a mix of factors. A small number of respondents gave 'environment' as an underlying reason, others referred to firm policy and tradition. The category also includes cases of unspecific and unknown drivers.

Table 4 Percentage composition of drivers for undertaking solid waste initiatives

Initiative	Legislation	Cost	Customer/ Supplier	Health & Safety	Public Image	Misc	**All**
Republic of Ireland/UK	8.7 (16.5)	69.6 (131.5)	8.5 (16)	1.6 (3)~~3~~	1.1 (2)	10.5 (20)	**189**
Germany	38.3 (184)	40.4 (194)	12.3 (59)	0.2 (1)	0.3 (1.5)	8.4 (40.5)	480

* Where figures are not whole numbers they refer to cases where more than one driver was reported. e.g. between cost and customer/supplier.

Types of initiative driven by legislation and external pressures in Germany

Table 5 shows, for all industries sampled, the types of initiative which were driven by regulation, cost and external (customer/ supplier) pressures. These data are for Germany where regulatory and external pressures on solid waste initiatives were most important.

Examination of the various sub-categories of solid waste initiative shows a variation in the importance of different drivers. While reuse efforts have either been traditionally in place or are explicitly undertaken for cost reasons, recycling efforts are undertaken for cost reasons except by retailers who reported that their recycling activities were mainly driven by legislation. Special design and material switch were undertaken for cost reasons only in a minority of cases, the main reasons were legislative and subsequent customer/supplier pressure. Packaging recovery, reduction of labels/volumes and waste segregation were the activities with the highest frequency of legislative pressure. Lightweighting was mainly undertaken for cost reasons (in order to save DSD fees as a filler (and thereby indirectly driven by legislation) or to save material costs as a packaging producer); retailers felt that their lightweighting of transit packaging was undertaken as a clear result of the new packaging legislation. Waste reduction (i.e. compacting of waste) was clearly undertaken in order to save transport costs.

New designs to remove outer packaging, the introduction of larger packs and the elimination of excess packaging were undertaken for legislative reasons in nearly 50 per cent of cases and, to a lesser extent, for cost reasons.

Table 5 Percentages of solid waste initiatives attributed to different drivers, all industries, Germany

Initiative Description	Legislation.	Cost	External Pressure	Miscellaneous
Reuse Materials	8	29	28	35
Recycle Materials	38	58	1	2
Special Design	55	5	23	18
Material Switching	40	17	43	0
Packaging Recovery	65	33	2	0
Lightweighting	20	49	31	0
Packaging reduction	50	32	15	3
Waste Reduction	14	80	6	0
Waste Segregation	61	34	5	0
Waste Reduction	0	80	0	20
Total	34	42	13	10

Direct customer/supplier pressures: environmental pressures in the context of other pressures

Firms were also asked about the importance of direct environmental pressures from customers or suppliers, and pressures placed on suppliers, in comparison with other pressures. Although customer/supplier pressures on packaging were important they were only one of many pressures (others included price, hygiene, quality etc.).

While retailers in Germany noted that their customers were concerned about excess packaging, labelling, reusable bottles, animal rights etc., in the Republic of Ireland/UK, retailers were under little customer pressure, except to provide space for recycling banks. In the Republic of Ireland and UK the key decisions on packaging were made on the basis of marketing requirements, '..from the company's point of view competition is the main driver and what we are looking for is better packaging for marketing purposes i.e. a better look' and 'we don't want to target sales packaging because it's important for marketing the product.'

Were firms supplying major retailers under greater pressure to vary their packaging? An analysis of the number of initiatives undertaken by firms selling to leading retailers compared with all others sampled in the dairy/drinks industries, showed no evidence that such suppliers undertook more solid waste initiatives.

B Competitiveness Effects of Compliance with Regulation and External Pressures

Influence of regulation and external pressures

(a). Managers were asked a set of questions about the economic effects of undertaking waste initiatives (the questions are reproduced in Appendix 2), these are shown in Table 6. The vertical column divides these effects into three broad categories. The requirement for inputs: employment, machinery and additional capital/running expenditures. Financial savings arising from the initiatives, these can give rise to unit cost savings, where savings are attributable directly to the product and general savings where departmental costs are affected. The competitiveness effects of the initiative is captured in four different measures (in answer to separate questions) namely did the initiative give rise to a change in company competitiveness, in the view of the respondent, or changes in productivity, ~~(shown here as a fall), a fall in~~ price or ~~and a rise in~~ market share?

Table 6 Type of initiatives, number and percentage of effects[a]

Effects	ROI/UK	G
Employment	28[2] ~~(2 fall)~~	46[10] ~~(9 fall)~~
Machinery	46	1572~~9~~
Additional capital/running cost~~Capital cost~~	60	270~~14~~
Percentage of total	**39.3**	**47.8~~46.1~~**
Unit Cost	61[2] ~~(2 rises)~~	62[3] ~~3 (1~~
Savings	84~~83~~	229~~197~~
Percentage of total	**41.6**	**29.~~4~~~~30.8~~**
Competitiveness	11~~2~~	118[10]~~87~~ ~~(4 fall)~~
Productivity	21[9] ~~(9 rises)~~	41[32]~~38~~ ~~(30 rise)~~
Price	24	39[7]~~42~~ ~~(4 rise)~~
Market Share	11	28[2] ~~(6.5 fall)~~
Percentage of total	**19.7**	**22.8~~23.1~~**
Total effects	346	990~~844~~
Number of initiatives	189~~256~~	480
Effects per initiative	**1.83**	**2.06~~1.76~~**

Notes:

[a] Assume all changes in productivity, price and unit cost are falls (negative). Assume all changes in competitiveness, employment, market share and machinery are rises (positive). A superscript shows the number of effects working in the opposite direction.

The table shows that a higher percentage of effects in Germany (compared with the ROI/UK) are attributable to resource inputs. Fewer are associated with cost savings while a similar percentage give rise to competitiveness effects.

The table also shows that in both countries, the employment implications of undertaking initiatives tends to be positive. Relatively few are associated with labour saving (as shown by a superscript). There is a general implication of a requirement for additional or modified machinery and of additional costs.

Unit cost savings are less frequent than general savings (though the two can overlap). Management's view of the competitiveness effects of initiatives are in many cases positive and supported by price reductions and improved market shares. Where there is an effect on productivity this is generally negative in the Republic of Ireland/UK, while in Germany it is on average beneficial, reinforcing the positive competitiveness effects reported.

Table 7 shows a breakdown of these effects by driver for each industry in Germany. It shows:

(a) that in the case of the packaging and dairy/drinks industries, initiatives driven by regulation were more likely to require additional resources (except labour), were less likely to create financial savings and were less likely to improve the competitiveness of the firm compared with non-regulatory drivers. There was little difference between

the effects of initiatives driven by regulatory and non regulatory drivers for retail firms.

(b). that initiatives driven by external pressure (customer/supplier pressure) were for the packaging and dairy/drinks industries less likely to require additional resources, less likely to generate unit cost savings and more likely to create positive competitiveness effects compared with other non-regulatory drivers. In contrast retailing firms were more likely to achieve cost savings but less likely to achieve competitive benefits.

Table 7 The Effects arising from Solid Waste Initiatives[a] (Germany)

	Cost			Legislation			External Pressures			All		
	P	D/D	R	P	D/D	R	P	D/D	R	P	D/D	R
Employment	4 [0.5]	6	7.5 [2]	4 [3]	1	11	5 [3.5]	1	4.5	13 [7]	10	23 [2]
Machinery	32.5	24	18	19	11.5	24.5	10.5	7	6.5	62	45	50
Capital/running cost	42.5	33	33	52	18.5	34	10	11	8	114	78	78
Percent of total	**38.5**	**55.6**	**50.9**	**68.0**	**68.1**	**48.9**	**28.8**	**31**	**51.4**	**43.4**	**52.0**	**50.5**
Unit Cost	24	3	1.5	5	2	3.5	15.5 [3]	6	-	45 [3]	12	5
Savings	63.5	33	27	19.5	9	36	11.5	5	13	99	53	77
Percent of total	**47.6**	**31.7**	**24.8**	**19.6**	**24.2**	**27.8**	**30.5**	**18**	**35.1**	**33.1**	**25.4**	**27.4**
Competitiveness	26.5[0.5]	5	23	13 [4]	0.5	24	8.5 [5.5]	9 [1]	3	50 [10]	18 [1]	50
Productivity	3 [3]	5 [4]	3 [3]	4 [1]	2.5 [2]	4.5 [4.5]	9 [7]	7 [7]	0.5 [0.5]	16 [11]	17 [13]	8 [8]
Price	6.5	1	3.5	5 [1]	-	3.5	14.5 [4]	6 [2]	-	26 [5]	8 [2]	7
Market Share	2.5	3.5 [0.5]	0.5	3.5[0.5]	0.5 [0.5]	1	4 [0.5]	9	1.5	10 [1]	15 [1]	3
Percent of total	**18.8**	**12.8**	**26.1**	**20.4**	**7.7**	**23.2**	**39.5**	**50.8**	**13.5**	**23.4**	**22.6**	**22.1**
Total effects	205	113.5	117	125	45.5	142	89	61	37	435	256	301
No. of Initiatives	99.5	48	47	80	31	62	28	12	22	234	112	136
Avg. effects	**2.06**	**2.36**	**2.45**	**1.56**	**1.47**	**2.29**	**3.16**	**5.08**	**1.68**	**1.86**	**2.29**	**2.21**

P=Packaging industries D/D Dairy and Drink industries R= Retailing

Notes: [a] As for Table 6

Cost implications

(1) Legislative driven initiatives

Table 8 focuses on the cost implications arising from legislative pressures in Germany. It shows that only a small number of initiatives involved capital expenditure, while the remainder involved running costs of which just over half were cost neutral to the firm. Many of these running costs refer to recycling expenditures and can be cost neutral depending on the market for secondary materials.

Table 8 Legislation driven solid waste initiatives in Germany and their associated costs*)

Cost Effects	Dairy/Drinks		Packaging		Retail		All Industries	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Capital cost	1	3.4	3.5	5.0	1	2.9	5.5	4.0
Running cost	10.5	35.6	36	51.1	11.5	33.9	58	43.3
No cost effects	18	61	31	43.9	21.5	63.2	70.5	52.7
Total	29.5	100	70.5	100	34	100	134	100

*) Figures relate only to the number of initiatives where quantitative data were available, i.e. "management time", "labour" etc. was not included. Costs which were reported as "cost neutral" were included as zero cost effect. Half effects are a result of split drivers like cost/legislation.

(2) Initiatives driven by external pressure

Table 9 shows that 10 initiatives, a quarter of the initiatives which were driven by external pressure, involved capital expenditure. The remainder involved raised running costs of which virtually all were cost neutral. These costs, unlike those incurred with respect to regulatory driven solid waste initiatives, occurred within the firm, where they were cost neutral this arose through lightweighting, material reuse, material switching etc.

Table 9 Externally driven solid waste initiatives in Germany and their associated costs*)

Cost Effects	Dairy/Drinks		Packaging		Retail		All Industries	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Capital cost	6	85.7%	4	13.8%	0.5	5.9%	10.5	23.6%
Running cost			4	13.8%			4	9.0%
No cost effects	1	14.3%	21	72.4%	8	94.1%	30	67.4%
Total	7	100%	29	100%	8.5	100%	44.5	100%

*) Figures relate only to the number of initiatives where quantitative data were available, i.e. "management time", "labour" etc. was not included. Costs which were reported as "cost neutral" were included as zero cost effect. Half effects are a result of split drivers like cost/legislation.

(3) Comparisons of waste costs

Table 10 shows the distribution of solid waste costs (including landfill and net recycling costs) for Ireland/UK and Germany for the dairy/drinks and retail industries. Figures in brackets show costs inclusive of DSD charges. DSD costs fall on the packer/filler, in this case it is the dairy/drinks industries and to some small extent the retailer in the form of secondary packaging passed on to the customer. The table shows that waste costs are higher for firms in Germany. The differential is small but

much larger for the dairy drinks sector inclusive of DSD charges.

Table 10 Distribution of Solid Waste Costs (Landfill + Recycling) figures in parentheses include DSD costs

Dairy/Drink

% of T/O	UK / Ireland	Germany
< 0.01	6	6
0.01 - 0.03	3	1
0.03 - 0.05	1	5
0.05+	3	3 (15)
All	**13**	**15**
Mean	**0.04**	**0.05(0.61)**
Median	**0.012**	**0.025(0.30)**

Retail

% of T/O	UK / Ireland	Germany
< 0.05	2	1
0.05 - 0.1	2	3
0.1 - 0.2	1	5
0.2+	1	1
All	**6**	**10**
Mean	**0.10**	**0.11(0.12)**
Median	**0.0442**	**0.1035 (0.105)**

Firm performance and waste costs

Table 11 shows the relationship between waste costs and plant and firm performance in the dairy/drinks sector using output measures of efficiency. Performance is defined by productivity (value added per head), employment growth and export propensity. Solid waste costs are shown for firms and plants in the top quartile of each measure of efficiency. Hence solid waste costs in the dairy/drink sector in the Republic of Ireland/UK sample were 0.03 per cent of sales as compared with 0.04 per cent for the sector as a whole. It is hypothesised that there is a negative relationship between plant performance and environmental costs.

Table 11 ***Waste costs, firm and plant performance: output measures Dairy/Drinks sector***

	Republic of Ireland/UK	**Germany**
Firms in top quartile measured by	Solid waste costs (% sales)	Solid waste costs (% sales)
Value added per head	0.03	0.68
Plant growth	0.05	0.16
Exports	0.02	0.97
All	0.04	0.61

While there was some support for the hypothesis that better performing firms (those in the top quartile of firm performers in the sample) had lower than average solid waste costs in the Republic of Ireland/UK samples, the reverse was the case in Germany where solid waste costs (inclusive of DSD charges) were significantly more important.

Importance of environmental factors influencing the firm's competitive performance relative to other factors

Respondents were asked to specify the competitive advantages and disadvantages they faced, these are shown in Table 12.

(a). Most advantages related to non-price factors especially product quality and variety, design and presence in niche markets. Environmental factors occurred infrequently. In Germany two companies in the dairy/drinks industry stated that their environmental initiatives conferred important competitive advantages, and only paper and board firms stated that the environmentally friendly quality of their products conferred an advantage. Three packaging firms in the Republic of Ireland/UK sample claimed an advantage for environmental reasons.

(b). Environmental factors were mentioned on even fewer occasions as a competitive disadvantage. Two German companies reported losses in market share because of strict environmental regulation. Both produced PVC. One paper company had lost market share on folding cartons due to the Packaging Ordinance, another said that lightweighting created a competitive disadvantage because it raised quality problems for the packer/filler which would eventually impact on the carton producer. No Republic of Ireland/UK firm reported that environmental matters constituted a competitive disadvantage.

(c). No firm cited environmental regulation or costs as a constraint on growth. In Germany overcapacity, raw material costs, fierce competition, low margins and transport costs were more frequently cited.

Conclusions

This study was unusual in its detailed focus on individual firms and, indeed, on its consideration of such firms right along a supply chain from packaging suppliers, through dairying and soft drinks processors, to the retailers to the final consumer. The attempt was to generate policy advice informed by such a micro perspective. Whilst the focus was on environmental outcomes these were considered alongside competitiveness issues. We were therefore considering the question whether for individual firms at various points along the supply chain environmental compliance was a cost and if so to what extent or whether in fact it represented a gain to competitive advantage.

Table 12 (a) Competitive Advantages: main factors and numbers of responses

	Dairy/Drink		Retail		Packaging	
	Irl/UK	**Germany**	**Irl/UK**	**Germany**	**Irl/UK**	**Germany**
Service	7	3	4	2	4	5
Price	5	1	4	1	3	1
Wages						
Hygiene					1	
Variety	6	1	3	4		1
Image						
Convenience			1			
Monopoly					3	3
Size			1	4	3	
Suppliers						
Location	2	4	2		2	4
Marketing	4	2	1	1	3	2
Versatility	2	4	1	1	4	9
Environmental factors		2			3	5
Quality	7	9	6	3	8	
Labour quality	11	1	1	2	2	
Design		1			4	11
Part of Group		1				1
Exports		1				
Own Brand		1				
No. of Depots				2		
Niche Products						6
Established	1				3	
Networks					2	

(b) Competitive Disadvantages: main factors and numbers of responses

	Dairy/Drink		Retail		Packaging	
	Irl/UK	**Germany**	**Irl/UK**	**Germany**	**Irl/UK**	**Germany**
Service		1		1		
Price	4	5	1	2	3	6
Wages						8
Hygiene	1					
Variety	1	1	2			
Image		1	1			
Convenience		1			3	
Size	1	3	3	1	3	4
Suppliers					2	
Location	3				4	4
Marketing	2	3		3	1	
Versatility	1				1	
Environmental factors		2				3
Quality				1		
Labour quality	2	1	2	1	2	1
Design	1				2	3
Shrinking Mkt.		1			4	
Transport costs	3					

In Germany, relatively more so than in the Republic of Ireland/UK, legislative requirements were an important driver of company environmental behaviour. The

Packaging Ordinance was shown to give rise to new or increased waste initiatives, particularly important were recycling, special design, material switching, packaging recovery, and packaging reduction (especially removal and reduction of labels and the removal of outer packaging, use of larger packs and the elimination of excess packaging). External pressures (many also following the Ordinance) gave rise to increased material reuse, special design, material switching, lightweighting and the removal of outer packaging. From a policy point of view it was of note that the relatively strong regulation in Germany had indeed some effects in terms of company behaviour.

To the extent that there is a trade off between environmental outcomes and company competitiveness then we would ideally wish to know how strong this was. Additionally, if the political judgement was that environmental outcomes should be attained even at the cost of diminished competitiveness then the aim would be to design policies where this cost was minimised.

It is very important to note that there was little evidence of regulation as leading to a competitive disadvantage. At the micro level there was some evidence of competitiveness benefits arising from regulation and external pressures but these advantages were not evident at the firm level. Probably the most important reason is that the impact of regulation and the cost of complying with regulation is relatively insignificant in relation to other factors which influence the competitive performance of firms between countries in the EU. Policy makers should therefore note that, at least up until now, the power of environmental regulation to do a great deal of harm or good to company competitiveness within the EU has been limited.

This would seem to imply that *at the margin* further upwards pressure on standards of regulation is unlikely to have much by way of trade off with competitiveness. Two qualifications to this conclusion should be added. First, this study focused on competitiveness comparisons *within* the EU though we did not uncover any evidence that regulations were placing the EU companies at a serious disadvantage relative to counterparts in the Newly Industrialised Countries or, say, Eastern Europe. Second, we can really only speak about changes at the margin. If, say, standards were to be suddenly doubled or tripled in intensity then the story might be very different.

The research has extended an earlier study by the authors (Hitchens et al, 1998a, 1998b) which considered the impact of the regulation of effluent on competitiveness of firms in the dairy and meat industries across the two Irish economies, Germany and Italy. That study too found no clear evidence of an adverse or beneficial effect on firm competitiveness.

There are a number of ways in which the research methodology adopted here could be improved in order to increase the reliability of the research findings. In particular the consideration of larger samples and other sectors would be necessary to be more certain of a number of the suggested findings. In addition, the analysis has not measured the relative importance of the different waste initiatives. To do so would require an even more detailed approach and would tend to argue against the use of larger sample sizes and to focus even more on a case study approach.

Appendix 1
Packaging legislation in the study areas

UK legislation
The EU Directive was to be incorporated into British law by the 30th June 1996, with targets to be met by the end of 2001 (different laws and arrangements apply in Northern Ireland which is considered below). In fact, the Directive was not incorporated into law until early in 1997, but there is every intention of meeting targets by the end of 2001.

"Duty of care" and responsibilities for disposal
UK regulations have specified a "duty of care", which ensures that waste is passed into proper hands and that it becomes the legal responsibility of each person who handles it, from its initial generation until its final disposal. The shares of responsibility or obligation- across the packaging chain are as follows:

Raw materials + imports	6 %
Materials converters + importers	11%
Packers / fillers + importers	36%
Retailers + importers + distributors	47%

Only those firms involved in one or more of the following activities are therefore affected by the new regulations[4]:

- the manufacturing of packaging raw materials
- converting materials into packaging
- using packaging to pack products or putting products into packaging
- selling packaging to the final consumer

The Environment Act 1995 allows for two courses of action for those forms obligated by the legislation, either:
(1.) to carry out the recovery and recycling obligation itself *(individual compliance)*,
(2.) or, to join a registered *compliance scheme*. Membership of such a scheme will exempt the company from obligations entirely. Such schemes will assume responsibility for meeting recovery and recycling obligations on behalf of their members, although they will not take on responsibility for actually removing waste from the members' sites. Members of schemes will need to supply output data to the scheme.

Northern Ireland legislation
Government policy on environmental regulation in Northern Ireland is that environmental standards should be the same as those in Great Britain. However

[4] A threshold test applies. In all these activities also including firms involved in the processing/packing of imported materials/goods. Firms must pass both of these threshold tests to have obligations under these regulations: (1.) in 1997,1998,1999 a turnover of over £ 5 m. and in 2000 a turnover of over £ 1 m, and, (2.), designated packaging handled of 50 tonnes or more.

legislative delays cause Northern Ireland regulations to lag behind those of Great Britain standards for at least a few years.

All waste in Northern Ireland is controlled under the **Control of Pollution Act 1978.** However, **The Northern Ireland Water and Contaminated Land Order** will bring Northern Ireland in line with the rest of the UK by Autumn 1998. From 1999 obligated firms will have to register with the Environment and Heritage Service. The first year 1999-2000 will be spent collecting data, and it is hoped that by the year 2000 Northern Ireland will be meeting the recovery and recycling targets.

The firms affected by the new packaging regulations in Northern Ireland will be those which meet the same criteria (in terms of turnover and tonnes of packaging created or handled) as in the rest of the UK.

Republic of Ireland legislation

The reduction of waste in the Republic of Ireland is being sought through a number of routes: reducing and treating waste, optimal use and reuse of materials and resources; and the facilitation of better environmental management. The Minister for the Environment has laid down waste regulations under the Waste Management Act 1996, to facilitate the achievement by Ireland of the packaging waste recovery targets laid down in the European Parliament. The Waste Management Act 1996, provides the Minister for the Environment with Extensive powers to promote the *prevention, minimisation, recovery* and *safe disposal* of waste. It provides, in particular, for regulations to apply producer responsibility obligations in relation to waste recovery.

All companies (raw material manufacturers, converters, packer/fillers, distributors, wholesalers, retailers and also importers) are affected if turnover net of exports exceeds IR £1m. and packaging supplied to the domestic market is greater than 25 tonnes. While these threshold levels are more stringent than those currently applying in Britain or Northern Ireland, it is worth stressing that the Republic of Ireland, along with Greece and Portugal, has been granted four extra years of grace in order to attain the recovery and recycling rates which the other EU countries are required to realise by 2001[5].

German legislation

Concerning this study the Packaging Ordinance ("Verpackungsverordnung", 12 June 1991 and revised draft version from 20 September 1996 which is still under negotiation) is the most important ordinance whereby Germany has chosen stringent recycling targets for package materials. In 1995, according to the Ordinance, 80 per cent of all package waste has to be collected separately and 64 to 72 per cent (depending on the materials used) has to be recycled. Manufacturers, distributors and retailers are obliged to take back their package.

Due to the impracticability of each company taking back its own package material, the companies involved founded the DSD ("Duales System Deutschland GmbH") on 28

[5] The EU packaging Directive requires Ireland to attain the following targets: by 30 June 2001, recovery of a minimum of 25% by weight of all packaging waste, and by 31 December 2005, recovery of a minimum of 50% and a maximum of 65% by weight of all packaging waste: such recovery must include - recycling of 25% of packaging waste, and recycling of a minimum of 15% of packaging waste from each individual packaging material.

September 1990, a private disposal company which is responsible for the collection, sorting and reprocessing of used sales packaging materials of its participating companies. The foundation of the DSD was initiated by about 400 companies from the retail sector, the manufacturing industry producing consumption goods, the packaging industry and raw material producers. The DSD secures the financing of the disposal and also serves the goals of the Packaging Ordinance (achievement of pre-set recycling quotas). The DSD makes the participants pay a license fee for every product disposed, the license symbol is the so-called green dot. Precondition for obtaining the green dot is a recycling guarantee for the respective material given by the packaging industry and/or the disposal industry. Thus the responsibility for the actual recycling does not lie with the fillers.[6] Currently the recycling guarantee for glass is given by one company, that for paper by four companies. Two companies guarantee for the recycling of aluminium, five companies for tinplate, one for plastics, one for beverage containers and one company for other composites (DSD Annual Report, 1996). That implies that fillers simultaneously contract with the DSD GmbH (licence contract) and with the companies given the recycling guarantee recycling contract). Thus, the license fees are based on the contracts negotiated with recycling companies and cover costs for the collection, sorting and recycling of materials.[7]

The DSD fees depend in part on the material type and weight of packaging as well as a per unit charge which varies between Pf. 0.1 and 1.2. However, micro packaging (e.g. little pots of cream for coffee in blister packaging) are not charged per piece but in combinations (e.g. 15 of the coffee cream pots). Small packaging of less 200 ml. and of less 3 g. weight are not generally charged on a per unit basis. Similar rules have been effected for other small packaging with little volume. With respect to the ecological effects of the DSD fees, there is an incentive to lightweight packaging (as far it is still possible) and also a tendency to substitute, e.g. paper for plastics due to the differentiated fee structure. However, the incentive to substitute for the recycling unfriendly packaging of small portions is reversed since the packaging is not charged per piece, but en bloc. In general the fees do not reflect the varying degrees of recyclability of the materials because they are not sufficiently disaggregated (e.g. no distinction is made between the various types of plastic) (Öko-Institut, 1994).

The current German recycling targets of a minimum of 64 per cent and 72 per cent depending on the individual materials are more stringent than foreseen in the EC Directive on Packaging and Packaging Waste (94/62/EC). According to the EC Directive by 31 December 2001 recovery of a minimum of 50 per cent and a maximum of 65 per cent by weight of all packaging waste must be achieved. The recovery includes recycling of 25-45 per cent of packaging waste and a minimum

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[6] This implies that fillers can obtain the green dot without giving a recycling guarantee themselves and therefore the backward pressure on the packaging industry for innovative recycling techniques may be weakened. There is only competition between the diffferent types of materials, the competition between individual firms for innnovative recycling techniques is limited. Companies which develop new techniques can use them only efficiently when they gain the respective orders from the companies giving the recycling guarantee (Bundeskartellamt, 1993).

[7] The calculation of DSD fees is independent from the EC Directive on Packaging and Packaging Waste (94/62/EC). There is only an indirect relationship insofar as the European definition of waste is a little wider than the German definition in the current Packaging Ordinance from 1991. That means that in the future under the revised German Packaging Ordinance more packaging waste would have to be licensed within the DSD and fees could be affected. However, these effects were estimated to be of only marginal importance (personal communication with Dr. Jaeckel, Department of the Environment, Bonn, 2 October 1997).

recycling target of 15 per cent of packaging waste from each individual packaging material.

Appendix 2

Questions relating to the competitiveness impact of environmental initiatives.

Did this initiative change machinery along your production line? Yes --- No----
How much did it **cost** to implement this initiative ?
Capital Costs----------Running Costs----------

Have overall **production costs** increased or decreased as a result of this initiative?

Quantify the **cost savings** from this initiative? (e.g. £X per annum)----------
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What are the **effects of investing in this initiative** in terms of:

Employment ----------

Productivity ----------

Product Price----------

Sales & Exports ----------

Market Share----------

Competitive Advantages/Disadvantages----------

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