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ASSESSING the EFFECTIVENESS of DENMARK'S WASTE TAX

BY THE MID-1980s, Denmark had a serious waste disposal problem: Its per capita generation of waste was among the highest in Europe and rising; it was running out of landfill space, with Copenhagen set to exhaust its landfill capacity in a short time; and there was a great deal of concern about air pollution from incinerators. Denmark responded to this situation by adopting a comprehensive waste management policy that included an innovative tax on waste designed to promote the reuse and recycling of many types of waste. Now that the tax has been in place for a decade, there is enough data to assess its effectiveness.¹ Such an assessment has implications that extend far beyond Denmark. To date, six other countries in Europe (Austria, Belgium, Finland, France, the Netherlands, and the United Kingdom) have adopted waste taxes at the national level, and two others (Norway and Sweden) are considering them. Although the United

by Mikael Skou Andersen

Figure 1. The Danish waste tax

NOTE: 1 krone = \$0.145 (U.S.)

SOURCE: Author.

States is unlikely to adopt such a tax, local governments within the country are experimenting with pay-as-you-throw schemes for reducing the volume of waste that are quite similar to waste taxes. So far, the results of the Danish waste tax are encouraging, as the quantity of waste being brought to landfills and incinerators has fallen some 26 percent and recycling is up appreciably. But for the tax to realize its full potential, municipal waste authorities will have to change the way in which they charge for waste services and the tax will have to become a more integral part of corporate and institutional decisionmaking.

Design of the Tax

The Danish waste tax is a special tax that is levied on most of the household and industrial waste delivered to the country's landfills and incinerators. It was enacted by the Danish parliament in February 1986 and became effective on 1 January 1987.² The principal pur-

pose of the tax was to reduce the overall quantity of waste brought to such facilities, both to ease the pressure on Denmark's limited landfills and to lower dioxin emissions from incineration. It was also intended to be an integral component of the country's Action Plan for Waste and Recycling, which was presented to the Danish parliament in 1989 and which aimed to achieve a 54 percent recycling rate for all waste by 1996.³ The tax was not primarily intended to prevent waste from being generated, however. That goal is served by a number of measures at the national level, including a deposit-refund system for beverage containers, taxes on disposable tableware and rechargeable batteries, and a tax on domestic raw materials such as sand, stone, and others used in construction.

Some types of waste are exempt from the tax, the most important of these being sludge that is clean enough to use as fertilizer on farms. Other exemptions include hazardous waste, waste from hospitals, fly ash,

uncontaminated soil delivered to certified sites, straw, and wood waste. In addition, waste that is reused or recycled is not subject to the tax. To that end, the law provides for the tax to be refunded to the waste facility in cases where material initially delivered to a waste facility is subsequently removed for use. At present, this provision is mainly applicable to construction materials (which can be reused easily), but it could become the basis for more widespread recycling activities.

Since its inception, the tax has been increased several times (see Figure 1 on this page), the tax base has been broadened, and several other refinements have been introduced. Initially, all taxable waste delivered to municipal waste facilities was taxed at a uniform rate of 40 kroner (approximately \$5.80) per ton. At the beginning of 1990, the tax was extended to cover the waste delivered to private landfills and other private facilities as well. In 1992, the rate structure was altered to tax incinerator waste less than landfill waste, and starting in 1997 lower rates were introduced for waste delivered to incinerators with energy recovery capacity for both heat and electricity (as opposed to incinerators with just heat recovery capacity). At present, waste delivered to landfills is taxed at the rate of 335 kroner (\$48.60) per ton, that delivered to incinerators with heat recovery capacity at the rate of 260 kroner (\$37.70) per ton, and that delivered to incinerators with both heat and electricity recovery capacity at the rate of 210 kroner (\$30.45) per ton.

Overall, fiscal considerations have played as great a role in determining the level and structure of the Danish waste tax as environmental considerations have. In only one case was a specific waste-reduction target mentioned when rates were increased—the 1990 increase to 130 kroner (\$18.85) per ton was expected to reduce delivered waste 15 percent. The latest round of rate increases in 1997 was intended to shift taxes from income to pollution, however.

Pricing in the Waste Sector

Taxes such as the Danish waste tax alter behavior by raising the price of particular goods, services, or activities. They are probably most effective when the underlying market is highly competitive because prices do not always fully reflect costs in regulated markets. Denmark's waste sector, of course, does not operate in a competitive market. In fact, the sector is best described as a collection of local and regional monopolies that are heavily regulated by the national government. Municipalities have long been responsible for collecting and processing household and some industrial waste (although they may contract these functions out to private firms), and they have recently taken on the task of managing recycling as well. Moreover, only public authorities are permitted to operate the landfills and incinerators that handle household waste. (Some private landfills remain in operation, but no new ones will be allowed.)

Denmark's waste management laws draw an important distinction between "collected" waste and "instructed" waste. Collected waste is waste that is regularly collected and disposed of by the local municipality. Collection is mandatory in areas with more than 1,000 inhabitants, both for environmental and sanitary reasons and because municipally organized collection is believed to be the most efficient economically. Many municipalities have banded together to form regional waste authorities that operate incinerators or (less commonly) landfills. The structure and duties of these regional authorities vary greatly. In some cases, for instance, they have taken on the municipal authorities' responsibility for collecting and transporting local waste.

For nonhousehold waste and household waste in sparsely populated areas where collection is not required, local authorities issue "instructions" as to where to take it. The same is true for recyclables such as paper, cardboard,

glass, and certain types of reusable industrial waste, which are subject to specific regulations.

By law, municipal authorities must price waste collection services to cover the actual cost of providing these services; they are not permitted to make a profit on them. As a result, prices normally reflect the cost of collecting, transporting, and processing the waste, plus the national value-added tax of 25 percent and the waste tax. How much waste tax a municipality pays depends on a number of factors, including the efficiency of its collection and recycling operations and how much it relies on incinerators rather than landfills. Prior to the 1997 increase, it typically amounted to 16 to 20 percent of a household's waste bill; now it is 18 to 28 percent of that bill.

Because waste regulations do not specify how the pricing of waste collection is to be done, this is largely a matter of local discretion. Many municipalities charge general fees based on the size of the household's (or other entity's) waste bin and the frequency of collection (for both of which there are a small number of options). Importantly, however, the fees are generally based on volume rather than weight, so there is only a small incentive to increase recycling or otherwise limit one's waste. As a result, the municipal pricing system tends to undercut the waste tax (which is based on weight), rendering it less effective than it otherwise would be. Those who designed the waste tax were well aware of this problem, arguing that the tax was not meant to provide an incentive for individual households but "to make it more profitable for the refuse collection authorities in the municipalities to establish recycling and sorting systems."⁴

In the case of instructed waste, most households and other waste producers contract with a hauling company rather than taking their waste to the disposal site themselves. As a result, the waste tax is generally included in the hauler's bill rather than being paid directly. Although the tax's designers believed that it would create an incentive (particularly for firms) to generate less waste, it is not clear that all waste producers are really aware of this incentive. To the extent that they are, however, the tax offers a more powerful incentive than it does in the case of collected waste.

Results of the Tax

Figure 2 on page 14 shows the net waste delivered to registered sites (i.e., the total waste delivered to those sites less the waste removed from them for

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Incinerators such as this one in the Faroe Islands are an important way of disposing of waste in a country with limited landfill space, but they pose environmental problems of their own.

recycling (such as construction materials and slag and ash from incinerators)) from 1987 to 1995. Because it is important to distinguish between the sites that were registered before 1990 (which are generally large municipal sites) and those that were registered subsequently (which tend to be small, privately owned sites), the figure shows the two site categories separately.⁵ As indicated in the figure, there was a significant decrease in the quantity of waste delivered to sites registered before 1990 (1.0 million tons, or 26 percent) over the period in question. By the same token, there was a small decrease in the waste delivered to sites registered later (about 0.16 million tons). Because waste removals rose only moderately during the period, the trends for total waste delivered to waste sites closely resemble those for net waste delivered.

What types of waste have been reduced? The question is complicated by the lack of reliable statistics,⁶ but the best data available indicate that from 1987 to 1993 household waste decreased 16 percent, construction waste 64 percent, and mixed waste 22

Figure 2. Net waste delivered to registered sites, 1987–96

NOTE: Sites registered prior to 1990 are generally large, municipally operated landfills or incinerators; those registered from 1990 on are generally small, privately owned sites.

SOURCE: Author.

percent, while manufacturing waste increased 8 percent (see Figure 3 on page 15). It is surprising that household waste decreased while manufac-

turing waste increased—one would expect just the opposite from a tax that provides larger incentives to manufacturers than to households. As will be seen shortly, however, there is a logical explanation for this, which has to do with the ways in which the two groups perceived the tax. It is less surprising that construction waste decreased so markedly because there has been a growing market for such waste for a number of years.

A closely related question is how much recycling has increased since the waste tax went into effect. Municipalities have been required since 1986 to maintain recycling facilities for certain items, notably paper, cardboard, glass, and food waste from large kitchens. The recycling of other types of waste is optional, but (as discussed more fully below) many localities have set up facilities for these types of waste. Even so, fewer than 15 percent of Danish municipalities have been able to achieve the 54 percent recycling rate required by the Action Plan for Waste and Recycling.⁷

The recycling of construction materials has risen significantly since Denmark began to implement its comprehensive waste management policy.

Figure 3. Gross delivered waste by type, 1987–93

SOURCE: RENDAN.

Figure 4 below shows the quantities of the different types of waste that have been recycled over various periods of time within the interval from

1986 to 1995. Construction materials registered the largest numerical gain, increasing from less than 800,000 tons in 1991 to more than 1.6 million tons

Figure 4. Recycling by type of waste, 1986–95

SOURCE: RENDAN.

in 1995. Overall, the recovery and reuse of such materials is quite high. In addition to the tonnages brought to the recycling sites, many tons of asphalt, tile, and concrete waste were brought to private crushers to be converted into forms suitable for building roads, toboggan runs, and other forms of infrastructure. The quantity of garden and organic household waste composted at municipal and regional facilities also rose significantly, from 86,000 tons in 1990 to approximately 500,000 tons in 1994. The reuse of fill (uncontaminated soil that is used in various civil engineering projects) rose sharply as well. Paper and cardboard recycling grew from 300,000 tons in 1986 to 531,000 tons in 1995 (with a potential of 1.0 million tons); glass recycling grew from 70,000 tons in 1986 to 105,000 tons in 1994 (with a potential of nearly 160,000 tons). In the case of one commodity, however—scrap metal—the quantity recycled failed to increase appreciably following the introduction of the waste tax. This probably reflects the fact that there has long been an active market for such scrap, with as much as 90 percent of it being reused at the time the tax went into effect.

At first blush, these results present something of a paradox. Recycling increased the most in areas that are not subject to regulation, notably construction materials and garden waste. Of course, such waste is generally heavy, and one would expect it to be particularly responsive to a tax based on weight. By contrast, in areas where there has been strong emphasis on recycling (such as paper and glass, for which there are recycling bins everywhere), recycling rose far less sharply following the introduction of the waste tax.

Determining the Role of the Waste Tax

Although the results presented above are suggestive, they do not permit us to draw firm conclusions about

(continued on page 38)

Denmark's Waste Tax

(continued from page 15)

the impact of the waste tax on the quantities of waste brought to processing facilities in Denmark. One reason for this is that the tax was introduced shortly after recycling was made mandatory for certain items, notably paper, cardboard, and glass, and that may have been the crucial factor in those cases. More generally, however, where numerous potential factors are at work, one cannot know why individuals and organizations behave as they do without asking them specifically. To find out how much of an impact the waste tax actually had, the author and two colleagues conducted what is known as a "backward mapping" exercise—in essence, a sociological survey of some of those involved in generating or disposing of waste.⁸ Because the designers of the waste tax thought that it would have its greatest effect on large firms and municipal waste authorities, the study focused on those two groups.

Large firms. From September to

December 1996, the researchers conducted in-depth interviews with executives at 15 private corporations and one public university. The corporations were from different parts of the country and represented a broad cross section of the Danish economy, including the iron and steel, brewing, printing, retail trade, telecommunications, and railroad sectors. To guard against the possibility of "strategic answers" (i.e., representing one's actions as being more altruistic than they actually are), the researchers focused first on the respondents' waste management practices in general and only then inquired about the effects of the waste tax.⁹

The interviews revealed that 3 of the 16 respondents had not taken any specific measures to reduce waste or increase recycling, though they did recycle items such as paper and metal. The remaining respondents had actively tried to increase their recycling in ways ranging from simply reusing materials on hand to redesigning production processes to incorporate waste products. The rail company, for instance, reported that it recycles more

than 50,000 tons of broken stone from its tracks every year, while a newspaper printer stated that it had adopted a thinner paper. Although one iron and steel firm said that it had asked its suppliers to alter the steel plates it purchased from them to cut down on the quantity of resulting scrap, such actions were rare.¹⁰

Interviewees were also asked to identify up to three factors that had contributed to their decision to reduce waste and increase recycling. Ten firms mentioned the possibility of obtaining income from waste products, while 8 said that they wished to reduce their waste bill. Of the latter group, however, only 2 stated that the waste tax was a key factor in their decisionmaking; the others said it had had no influence on their waste management practices. A number of other factors were named, including municipal regulations (7 respondents), the desire to improve corporate image (8 respondents), pressure from customers (2 respondents), and the environmental permitting process, which gives municipalities the opportunity to raise standards (4 respondents). Because the interviews were conducted shortly before the waste tax was scheduled to increase, interviewees were also asked what effect this would have on them. Four indicated that they planned to alter their waste management practices in some way, 8 said that they did not plan to make any changes, and some were not aware of the pending tax increase.

There were also some interesting differences among the sectors surveyed. The breweries, the iron and steel producers, and the rail company generally had the most professional waste management operations and were most aware of both the waste they were producing and the costs of the alternative ways of disposing of it. The printing companies had a positive attitude toward recycling but were generally ignorant of the costs and benefits of various waste disposal options. The remaining respondents,

Along with incinerators, municipal landfills such as this one are the fulcrum of the waste tax. How they incorporate it into their waste charges has a strong bearing on the tax's effectiveness.

which included supermarkets, a telecommunications company, and the university, tended to be rather negligent about waste management. For instance, the telecommunications company, which until recently enjoyed a monopoly, was not effective in recycling cable and metal, while one of the supermarkets simply passed its waste bill on to the head office. This behavior is unfortunate because the quantity of waste generated by such groups is fairly substantial.

The interviews also suggested that many firms and nonprofit organizations do not know the true cost of their waste disposal operations and the potential benefits of adopting greener alternatives. There are two general reasons for this. First, there is little integrated accounting for waste management activities, so it is often difficult to pinpoint what those activities actually cost. Second, the cost of waste management is low relative to other costs (seldom more than 0.5 percent of a company's total turnover), so executives tend not to give it much attention. As a result, in most cases the interviewers had difficulty obtaining accurate cost information even when they repeated the request for it.¹¹

Municipal waste authorities. In December 1996 and January 1997, all 277 of Denmark's municipalities were sent a questionnaire asking about the particular recycling opportunities they offered their residents and their reasons for doing so. Some 68 percent responded, a response rate that is good for surveys of this sort. The results are shown in Figure 5 on this page. Because municipalities are required to recycle paper, cardboard, and glass, it is not surprising that all the respondents reported doing this. But many municipalities recycle other types of waste as well. At least 70 percent of the respondents do this with scrap metal, construction waste, bulky waste such as old furniture and refrigerators, and garden waste. In addition, at least 40 percent handle plastics and organic household waste. By and large, munic-

Figure 5. Percent of municipalities with recycling facilities for various types of waste

SOURCE: Author.

ipalities established their various recycling systems in three "waves": Paper and glass facilities appeared before 1990, facilities for construction waste, bulky waste, and garden waste from 1987 to 1992, and those for organic household waste since 1993.

To determine why municipalities had created the particular facilities that they had, the questionnaires offered respondents a choice of eight possible reasons and asked them to list the three most significant ones for each category of waste. The reasons included legal requirements; compliance with the Action Plan for Waste and Recycling; lack of landfill space or incinerator capacity; the desire to reduce waste processing costs (including payment of the waste tax); pressure from residents; the insistence or suggestion of the regional waste utility; the availability of subsidies from the Recycling Council for innovative measures (from 1987 to 1992); and the municipal council's (political) desire to increase recycling. (An "other" category was also provided, but this was seldom used.)

The responses indicate that the last reason offered—the municipal council's desire to increase recycling for political reasons—was the most sig-

nificant one for all waste categories. The desire to reduce cost was generally the second most important factor, especially for the heavier types of waste such as garden waste, bulky waste, and construction waste. Furthermore, more than 70 percent of the respondents said that the waste tax played "some" or "a decisive" role in their decision to establish facilities for such waste (for construction waste, nearly 50 percent said that the tax played a decisive role).

It was noted above that even with the widespread establishment of recycling facilities, fewer than 15 percent of Danish municipalities have been able to meet the target set by the Action Plan for Waste and Recycling. This implies that the facilities are not being used to the extent envisioned. One possible reason for this is that municipalities generally base their fees for waste-related services on volume rather than weight. As a recent comparative study indicates, recycling rates tend to be higher in those municipalities that use weight as the basis for such fees.¹²

The two communities that have experienced the largest reductions in residual waste (waste after recycling) are Tinglev and Bogense, both of

which introduced weight-based fees in the mid-1990s. In these communities, residual waste has fallen to about 100 kg per capita, compared with 200 kg to 250 kg per capita in communities that have established recycling facilities but not adopted weight-based fees.¹³ Implementing a weight-based system may not be straightforward, however. In Tinglev, for instance, the trash trucks are equipped with a weighing device and an electronic scanner that reads the identity tag on each trash bin. The weight of each household's trash is recorded on a diskette, and the appropriate waste charges are added to that household's property tax bill at the end of the year.¹⁴ Although such a system works well in a small, rural community like Tinglev that consists mainly of single-family homes, it might be problematical in a larger, more urban area.

If the practical problems can be overcome, weight-based waste fees would very likely increase the recycling rate in Danish communities. The reason, of course, is that such charges would work with—not against—the weight-based waste tax, sending the proper price signal to waste producers at all levels.

Final Observations

In the ten years from 1987 to 1996, Denmark achieved a 26 percent reduction in the quantity of waste brought to its municipal landfills and incinerators and attained an overall recycling rate of 61 percent. This was the result of a comprehensive waste-reduction policy with several elements, including a special tax on waste. More than 80 percent of the reduction occurred in areas not subject to regulation, such as construction materials and garden waste, where the establishment of new recycling facilities played a prominent role. Particularly in the case of construction materials, the waste tax may have been important in promoting recovery and reuse.

Despite these impressive results, it

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appears that the waste tax has not had as much impact as expected, especially among large firms and comparable nonprofit institutions. Although those who designed the tax thought that such cost-conscious organizations would be especially responsive to it, in-depth interviews with their executives suggest the opposite: Most were not really aware of the tax or the possible cost savings to be had from adopting more environmentally enlightened waste management practices.

Overall, municipal waste authorities were more responsive to the waste tax than were corporate and institutional leaders. This is surprising because municipal authorities are in a position to simply pass the tax on to local residents. Further study will be necessary to resolve this issue, but one possible reason why the municipal authorities were more responsive to the tax is that waste management is their primary focus. For most firms and institutions, by contrast, waste is a side issue that attracts limited attention from top management. (The only exception to this lies in industrial sectors such as brewing and iron and steel production, which have well-established markets for waste products.)

Results to date suggest one other lesson about waste management: Recycling rates tend to be highest where municipal authorities base collection and/or processing charges on weight rather than volume. Until this practice becomes more widespread, Denmark's waste tax (which is the highest in Europe) will be unlikely to reach its full potential.

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NOTES

1. This article summarizes a report on the tax that the

author and two colleagues prepared for the Danish Environmental Protection Agency. See M. S. Andersen, N. Dengsø, and S. Brendstrup, *Affaldsaffigten: En ex post evaluering af incitament og miljøeffekter* (The waste tax: An ex post evaluation of incentives and environmental effects), Danish Environmental Protection Agency Report No. 96 (Copenhagen, 1997) (with English summary).

2. The tax was originally proposed by Denmark's Environmental Protection Agency in 1985. See Environmental Protection Agency, *Miljøafgifter* (Environmental taxes and charges) (Copenhagen, 1985).

3. Though not yet realized, this goal remains in effect.

4. Law Proposal 176 (1986), *Folketingstidende* (Parliamentary bulletin), column 4425. It was implicitly assumed that the tax would induce municipal authorities to minimize costs rather than simply passing the tax on to residents.

5. Ninety-three sites were registered prior to 1990, 65 in 1990, and an additional 25 in later years.

6. There are three main sources of data on waste in Denmark: the waste planning data compiled by the counties in 1985; the so-called material surveillance statistics compiled by the waste consulting firm RENDAN from 1987 to 1993; and a new information system on waste and recycling begun by the Danish Environmental Protection Agency in 1993. The first source is somewhat unreliable, while the third does not provide a long enough series for analysis (nor is it compatible with the other sources). Thus, the RENDAN data were used. These data provide a reasonable time series for total delivered waste. Although the series originally covered only the large waste sites, the missing data from the small sites have been estimated on the basis of tax receipt data.

7. See J. H. Larsen, *Opfylder din kommune målene for affald og genanvendelse?* (Does your municipality meet the targets for waste and recycling?) (Copenhagen: The Conservation Society, 1996). Municipalities that operate their own incinerators may have a built-in incentive not to increase their recycling rate because doing so would leave them with excess incinerator capacity.

8. For more on the use of this technique to study the effectiveness of economic policy instruments in the environmental area, see J. Schuurman, *De prijs van water* (The price of water) (Arnhem, the Netherlands: Gouda Quint, 1988); and M. S. Andersen, *Governance by Green Taxes: Making Pollution Prevention Pay* (New York: Manchester University Press, 1994).

9. With their corporate image at stake, respondents whose waste practices were actually based on the waste tax might be tempted to say that they were based on general concern for the environment instead.

10. See Andersen et al., note 1 above.

11. There was one important exception—the two breweries in the sample. These firms apparently had very detailed knowledge of waste-related costs and benefits but would not release it for reasons of confidentiality.

12. State Building Research Institute, *Affald i boligområder: Livsstil og affaldsvaner* (Waste in residential areas: Lifestyle and waste habits) (Copenhagen, 1996).

13. The only community that has been able to achieve comparable reductions in waste without weight-based charges is Vejle, which has extensive curbside collection of recyclables. This approach is very expensive, however. Even with a large subsidy from the Danish Environmental Protection Agency, household waste charges are more than twice as high in Vejle as in Tinglev and Bogense.

14. Environmental Protection Agency, *Vægtafhængig dagrenovation: Tinglev kommune* (Weight-based refuse collection in Tinglev) (Copenhagen, 1994).

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