
E. Dijkgraaf
R.H.J.M. Gradus
Editors
The Waste Market
Institutional Developments in Europe
Springer

The Waste Market

The Waste Market

Institutional Developments in Europe

Edited by

E. Dijkgraaf
SEOR-ECRi, Erasmus University Rotterdam, Rotterdam, The Netherlands

and

R.H.J.M. Gradus
Faculty of Economics and Business Administration, VU University Amsterdam, Amsterdam, The Netherlands

Springer

E. Dijkgraaf
SEOR-ECRi
Erasmus University Rotterdam
P.O. Box 1738
3000 DR Rotterdam
The Netherlands

R.H.J.M. Gradus
Faculty of Economics and Business Administration
VU University Amsterdam
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands

ISBN: 978-1-4020-8710-3 e-ISBN: 978-1-4020-8711-0

Library of Congress Control Number: 2008930933

Printed on acid-free paper

9 8 7 6 5 4 3 2 1

springer.com

Contents

Contributors

Germà Bel
Universitat de Barcelona and ppre-IREA, Dep. de Política Econòmica,
Av. Diagonal, 690 08034 Barcelona, Spain, e-mail: gbel@ub.edu

E. Dijkgraaf
SEOR-ECRi, Erasmus University Rotterdam, P.O. Box 1738,
3000 DR Rotterdam, The Netherlands, e-mail: dijkgraaf@few.eur.nl

X. Gellynck
Department of Agricultural Economics, Ghent University, Coupure links 653,
B-9000 Ghent, e-mail: xavier.gellynck@UGent.be

R.H.J.M. Gradus
Faculty of Economics and Business Administration, VU University Amsterdam, De
Boelelaan 1105, 1081 HV Amsterdam, The Netherlands, e-mail: rgradus@feweb.vu.nl

B. Melenberg
Tilburg University, K 615, P.O. Box 90153, 5000 LE Tilburg, The Netherlands,
e-mail: b.melenberg@uvt.nl

H. Ohlsson
Department of Economics, Uppsala University, P.O. Box 513, SE-751 20 Uppsala,
Sweden, e-mail: henry.ohlsson@nek.uu.se

R.J. Sørensen
Department of Public Governance, Norwegian School of Management, Nydalsveien
37, 0484 Oslo, Norway, e-mail: rune.sorensen@bi.no

P. Verhelst
Department of Agricultural Economics, Ghent University, Coupure links 653,
B-9000 Ghent, e-mail: Pieter.Verhelst@UGent.be

Chapter 1
Introduction

E. Dijkgraaf and R.H.J.M. Gradus

1.1 Introduction

In 2004 Elbert Dijkgraaf finished a PhD-thesis 'Regulating the Dutch waste market' at the Erasmus University Rotterdam. It was interesting that not much is published about the waste market, although it is a very important sector from an economic and environmental viewpoint. In 2006 we were participants at a very interesting conference on Local Government Reform: privatization and public-private collaboration in Barcelona organized by Germà Bel. It was interesting to notice that researchers from Spain, Scandinavian countries, the UK and the USA were studying this issue as well. From this we brought forward the idea to publish a book about the waste market. Because of its legal framework we want to focus on Europe.

In this chapter we give an introduction to this book. In the next paragraph we present a short overview of the waste collection market. Since 1960 the importance of the waste sector has increased substantially both in the waste streams and the costs of waste collection and treatment. Furthermore, we discuss policy measures to deal with these increases and give an overview of the different measures in EU-countries. In the last paragraph we present different chapters of our book.

1.2 Empirical Update of the Waste Collection Market

The Dutch case provides a nice example why studying the waste market is interesting from an economic point of view. The quantity of waste in kilograms per Dutch inhabitants has more than doubled in the last 90 years (see Fig. 1.1). After

✉ E. Dijkgraaf
SEOR-ECRi, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands
e-mail: dijkgraaf@few.eur.nl

R.H.J.M. Gradus
Faculty of Economics and Business Administration, VU University Amsterdam, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands
e-mail: rgradus@feweb.vu.nl

E. Dijkgraaf, R.H.J.M. Gradus (eds.), *The Waste Market*,

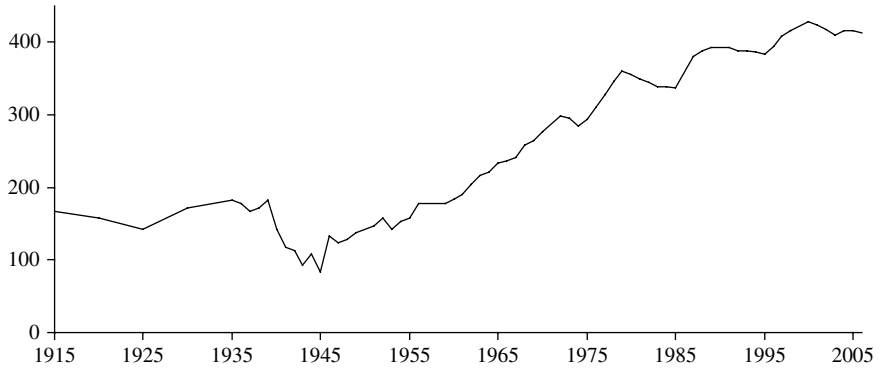

Fig. 1.1 Quantity of waste in kg per inhabitant, The Netherlands

2000 the level has stayed more or less stable on a level between 410 and 430 km per inhabitant.[1] As will be shown in this book (Chapter 8) the use of unit-based systems in some parts of the Netherlands in the last years is an explanation for this. Key question is than whether wider application of this system might result in much lower levels of waste and decreasing costs for citizens.

The increase in waste quantity and the changes in waste management policy resulted in a sharp acceleration of collection costs (see Fig. 1.2). In 1972 a Dutch

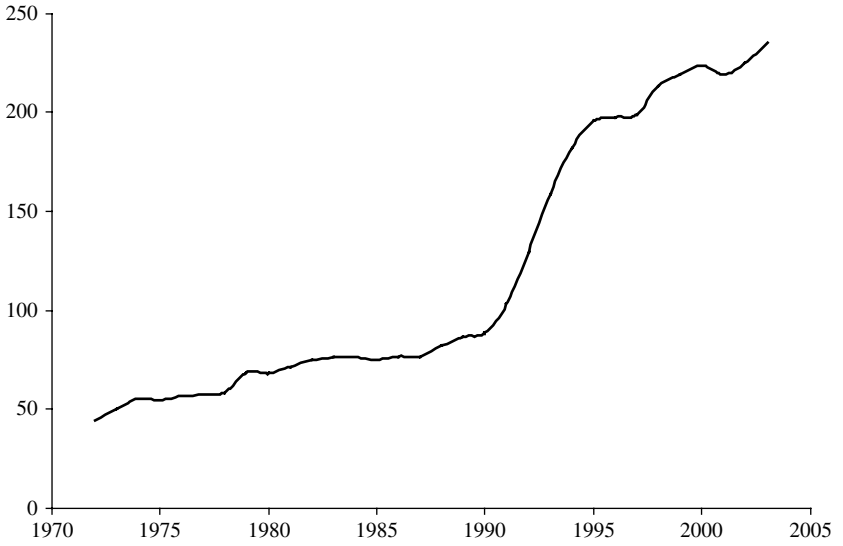

Fig. 1.2 Real costs waste in euro per household, The Netherlands

[1] Note that this includes the types of waste analyzed in this book. This is the sum of unsorted waste, recyclable waste (glass, paper, textiles) and compostable waste (vegetable, fruit and garden waste). We do not analyze demolition waste, chemical waste and other special types of waste.

household paid 44 euro per year on average for the collection and treatment of waste. In 1990 the real costs were already two times as high, while in 2003 a household paid more than five times as much.

This sharp rise in costs is not only a consequence of the increase of waste quantity, but also of the increased use of more expensive treatment options. Especially, the introduction of a landfill tax in 1996 and the introduction of more expensive incineration methods were important in this respect.[2] Due to this sharp increase several policy measures such as increasing private involvement of waste collection and unit-based pricing has been introduced with the goal to minimize waste collection costs. Main objective for this book is to learn from these experiences to get hold on possibilities to compensate the sharp rise in costs. This asks for an evaluation of the relation between costs and different policy measures such as privatization and variable charging as will be done in this book.

In 2002 a EU-study was published giving an overview of the extent of private involvement of refuse collection and variable charging (see Hogg, 2002). In Table 1.1 the differences between the EU-countries and Norway are summarized.

Table 1.1 Private sector involvement and variable charging in EU-countries

Country	Private sector involvement collection	Variable charging
Austria	50%	Widespread, usually on basis of volume
Belgium	Frequently	Widespread and increasing
Denmark	80%	10% of authorities, usually weight-based; some charge for additional bags
Finland	Municipalities dominant	Volume-based charging on residual waste
France	50%	14% of population, mostly volume based, some weight-based
Germany	Limited role	Widespread, by volume, amount of waste and sometimes frequency
Greece	Limited role	No variable charging
Ireland	40%	Being piloted, tagged bags, volume and weight based
Italy	46%	Will be compulsory, tags and average weight
Luxemburg	Some	Compulsory, mostly volume-based, some weight-based
Netherlands	38%	21% of municipalities, volume and volume/frequency are most common
Norway	10-15%	56% voluntary and 18% mandatory
Portugal	Limited role	No variable charging
Spain	56%	No variable charging
Sweden	60%	About 5% of municipalities, mainly based on size, some on weight
United Kingdom	50%	No variable charging permitted by law

Source: Hogg (2002, Table 1), Kipperberg (2007) and authors.

[2] This book only studies waste collection. See Dijkgraaf (2004) for an overview of the waste treatment market (landfilling and incineration) and options to reduce costs also in this market.

From Table 1.1 it is quite clear that private sector involvement differs across countries. In some countries, especially some Scandinavian countries such as Denmark and Sweden, the level of private sector involvement is large. In other countries such as Austria, the Netherlands and the UK, the level is less than fifty percent. In a third group, with countries such as Greece and Germany, there is a limited role for the private sector in waste collection. Although the results from this EU-study should be interpreted with caution as other studies give a slightly different picture and data can be outdated, it indicates that there is no firm one way trend in all EU-countries. Therefore, it is interesting to study the effects and reasons for privatization. Furthermore, variable charging or unit-based pricing also varies in its extent across EU-countries. Especially in the southern parts of Europe, except Italy, variable charging has not been implemented. In other countries such as the Benelux and the Scandinavian countries different forms of variable charging based on weight, volume and frequency are becoming more widespread and therefore are studied in several chapters in this book.

1.3 Description and Purpose of the Book

In this book we analyze the waste collection market in different EU-countries. In the previous paragraph we gave an empirical update of the waste market, which has changed considerable in the last thirty years. Especially in high densely populated countries or regions as the Netherlands, Belgium, Catalonia and the Stockholm area, waste management policies have resulted in an acceleration of waste collection and treatment costs.

In the following chapters several policy measures are discussed with the goal to generate more insight in the available policy options to reduce these costs. First, the cost advantage of contracting out refuse collection is analyzed. Second, evidence is presented for the incidence of contracting out related to this cost advantage. Key question is why private provision is not accepted as a best-practice and how this relates to issues like assuring enough control for municipalities, ideology, pressure groups and the dynamics of the market structure. This is done for the Netherlands (Chapters 1, 2, 3 and 7), Sweden (Chapter 4), Norway (Chapter 5) and Spain (Chapter 6). Third, the effects of unit-based pricing and other policy measures to decrease waste generation are studied based on experience in the Netherlands (Chapter 8) and Belgium (Chapter 9). Finally, Chapter 10 discusses items for future research.

Chapter 2 discusses the possible cost savings of contracting out refuse collection in the Netherlands. The findings indicate that similar to foreign econometric studies cost savings of approximately 15–20% apply to the Netherlands (for an overview see Domberger and Jensen, 1997). However, it should be noticed that contracting out is more important than the ownership issue because the difference in cost advantage between private and public firms is very small. In addition, compared with the existing literature it is shown that different production technologies apply to internal municipal waste collection units and external refuse collection firms. Different cost

functions have to be estimated for the sub-samples. Using different production techniques it is shown that out-side firms such as private or public firms can make more use of scale economies than municipal service or cooperation.

There are some reasons to doubt the cost-advantage result of private contracting out in a dynamic perspective (see also Bel and Warner 2006). Contracting out refuse collection is a dynamic process typically converging from a competitive market structure to a monopolistic one. Even though the bidding process may have been competitive, the market becomes a bilateral monopoly just after awarding the contract. Contracted firms will try to keep control over the contract by means of anticompetitive behavior against rivals. This might explain why the use of private collectors seems relatively low, despite the estimated cost advantages at short term. In 2006 in the Netherlands, 38% percent of the municipalities used private firms. So, more than 60% of the municipalities has public provision (public firms, municipal cooperation or municipal collection service). For the United Kingdom and Sweden similar pictures can be drawn (see Chapter 4 for Sweden and Szymanski (1996) for the United Kingdom).

It is, therefore, important to study political economy factors that induce or deter privatization. In Chapter 3 an explanation is sought for the reservations of Dutch local authorities toward privatization. Based on theoretical insights the choice is modeled between private and public provision of refuse collection on the one hand and the choice between in-house and out-house provision on the other. Data are available for nearly all Dutch municipalities in 1998. Evidence is found that the higher the number of inhabitants the less likely it is that municipalities will privatize. In addition, large transfers by the central government and strong interest by public unions discourage privatization. Interestingly, the results with respect to the political variables are much weaker. For out-house provision the over-all results are in line with privatization. Compared to earlier studies also more general models are estimated. Although the same qualitative results are found for parametric and semi-parametric models, strong statistical evidence is found that a parametric specification is too inflexible. In addition, semi-parametric models are more capable to investigate spatial models.

In Chapter 4 it is shown that municipalities did not choose the least-cost alternative using Swedish 1989-data. In other words, cost differences did not affect producer choice in Sweden. Interestingly, other variables as ideology, the influence of pressure groups and legal constraints did not fit the data as well. In addition, the dummy-variable approach which captures the difference between public and private production is rejected and therefore a pooling model is used, which also corrects for selection bias. In that case it is shown that public production is 6% cheaper than private production. This is interesting because the cost advantage of public versus private production is the reverse, although the difference is rather small.

A more general finding in the political-economy literature is that there do not seem to be many ideological biases influencing politician's decision. The decision of the municipality is often pragmatic and not ideological. It seems that some politicians are reluctant to privatization simply because they do not foresee relevant cost savings in the longer term. A possible explanation is that initial savings given by

privatization are diminished over time and the previous chapters seriously doubt the positive link between privatization and cost savings. Also in a recent meta-analysis of all published empirical refuse collection studies Bel and Warner (2006) show that there is little evidence for such a link.

In Chapter 5 the refuse collection process in Norway and the possible cost savings are discussed. Interestingly, in Norway only 10–15% of the municipalities use a private collector. It seems that privatization faces political opposition of the affected constituencies, which seems to imply that Norway is the less market oriented of the Nordic countries. However, to take advantage of economies of scale Norwegian municipalities are more willing to cooperate with other municipalities, which is the case for more or less half of the municipalities. In this chapter the internal governance structure is analyzed into more detail. It is shown that dispersed public ownership impairs inefficiency. Local governments that cooperate with neighbors to provide refuse services have costs that are 10% higher than those municipalities that supply the service single-handedly. In addition, if ownership is measured by the Herfindahl index of ownership concentration, estimates suggest that an increase in ownership concentration from 0 to 1 will reduce costs by 6% and an increase in the number of owners from 1 to 6 will increase costs by about 5%.

Chapters 6 and 7 describe the structure of the refuse collection market in more detail. Chapter 6 starts with analyzing the Spanish refuse collection market. Based on a 2003-sample for Spain, it is shown that the level of private provision (63%)[3] is higher than in some other European countries. Therefore, the Spanish system of municipal cooperation is described as it combines local grip with private provision. This system and the relatively low municipality size might explain the relatively high figure of private provision. With respect to the refuse collection market a dual market is faced. One single Spanish company concentrates more than 50% of the population served by private enterprises. Measured in the so-called Herfindahl index for Spain it is 0.33, which is a very high level. However, for the sub-sample of small municipalities this Herfindahl index and thereby the concentration is much lower. Nevertheless, Spanish private companies have significant market power in 2002 and it is, therefore, possible that the cost reductions of contracting out can not be sustained over time.

In Chapter 7 it is shown that the Dutch market for private refuse collection is highly concentrated as well. Moreover, it is shown that in highly concentrated provinces competition is weak, which results in barriers for local governments to effectively obtain benefits from contracting-out. However, according to our estimates this is only the case for private firms. It seems that the price behavior of public firms is not influenced by market concentration and in low concentrated provinces, where public firms are active, competition is strengthened. The importance of public firms is also put forward, if the increase of prices is related to the institutional form chosen. For the public firm dummy a significant negative effect is found meaning that prices go down if a public firm is chosen. However, the level of concentration does not

[3] This figure also includes so-called mixed-firms (see Table 6.1 of Chapter 6).

influence the cost saving effect of public firms, but the change in concentration does. Nevertheless, it seems an effective way to organize day-to-day operations under private commercial law rules, whereas the government retains control over strategic decisions. An important policy implication of this chapter is that local governments should be cautious with privatization of public firms.

In this book we analyze also unit-based pricing (UBP) as an instrument to lower refuse collection costs. With a UBP system the waste collection tariff depends on the amount of waste citizens produce. The idea is that this introduces an incentive for citizens to reduce the amount of waste compared with the generally used flat rate system. It is shown that unit-based pricing is much more effective in cost reductions of the costs of refuse collection than contracting out. From an environmental point of view this is important as well, because unit-based pricing systems are effective in reducing unsorted, the most environmentally unfriendly waste stream, and in stimulating recyclable waste.

In Chapter 8 the effects are estimated of four unit-based pricing systems (weight-, bag-, volume- and frequency-based) on waste collected using a panel data set for all Dutch municipalities. More than 20% of the Dutch municipalities had implemented such a system in 2000, while in 2005 this was already more than 30% (Dijkgraaf & Gradus, 2008). Unit-based pricing is shown to be very effective in reducing solid waste, composted waste and in increasing recyclable waste such as paper, glass and textile. If the estimations are corrected for differences in environmental activism between municipalities the effects are still large but significantly lower. The performance of bag- and weight-based systems is equal and compared with the frequency- and volume-based systems these two performs much better with a reduction of total waste of one third. This is interesting, as administrative costs are substantially lower for the bag-based system. Furthermore, unit-based pricing systems have no effect on the amounts of waste collected in surrounding municipalities.

Finally, the issue of illegal dumping, one of the adverse effects of the introduction of unit-based pricing systems is discussed as well. However, studying the effects of introducing a weight-based system in the Dutch municipality of Oostzaan Linderhof, Kooreman, Allers, and Wiersma, (2001) state that illegal dumping is virtually non-existent. According to them, the monitoring system in Oostzaan, with fines for illegal dumping, appears to be very effective in terms of deterrence. Moreover, another explanation for the absence of illegal dumping is that a small municipality such as Oostzaan has a large degree of social control. In general, the high population density of the Netherlands would suggest a low level of illegal dumping. This is confirmed by the lack of clear anecdotal evidence despite the large number of municipalities with unit-based pricing. Nevertheless, it shows that there is an important relation of unit-based pricing in relation to other policy variables as well.

Therefore, it is interesting to study the Flemish region of Belgium, where the authorities in the 'implementation plan household waste 2003–2007' assessed a broad policy mix (Chapter 9). It is shown that besides pecuniary incentives service level and measurements stimulating prevention and waste reduction are effective in reducing household solid waste. Instruments to reduce waste can be divided in three groups: pecuniary incentives; service level and measurements stimulating

prevention and waste reduction. Also specific characteristics of the community determine the amount of waste generated. The chapter analyses whether findings in the literature on effectiveness of policy measures are valid for Belgium, specifically for the Flemish region. Multiple regression analysis identifies those measurements having the greatest impact on household solid waste. An income elasticity is found of 0.33. Also the provided service level has a significant impact. Pecuniary incentives are effective instruments in reducing waste, with a price elasticity of -0.14. Furthermore, a higher percentage of direct costs, directly attributable to waste services, borne by households, reduces waste. A consequent implementation of the 'polluter pays' principle proves to be effective.

Finally, Chapter 10 provides issues for future research.

References List

Bel, G., & Warner, M. (2006). *Local privatisation and costs: a review of the empirical evidence*. Working paper University of Barcelona.

Dijkgraaf, E. (2004). *Regulating the Dutch waste market*. PhD-thesis, Erasmus University Rotterdam.

Dijkgraaf, E., & Gradus, R. H. J. M. (2008). *Environmental activism and dynamics of unit-based pricing systems*. Working Paper, Vrije Universiteit Amsterdam.

Domberger, S., & Jensen, P. (1997). Contracting out by the public sector: theory, evidence and prospects. *Oxford Review of Economic Policy, 4,* 67–78.

Hogg, D. (2002). *Costs for municipal waste management in the EU*. Final report to Directorate General Environment, European Commission, Brussels.

Kipperberg, G. (2007). A comparison of household recycling behaviors in Norway and the United States. *Environmental & Resource Economics, 31,* 215–235.

Linderhof, V., Kooreman, P., Allers, M., & Wiersma, D. (2001). Weight-based pricing in the collection of household waste: The Oostzaan case. *Resource and Energy Economics, 23,* 359–371.

Szymanski, S. (1996). The impact of compulsory competitive tendering on refuse collection services. *Fiscal Studies, 17,* 1–19.

Warner, M., & Bel, G. (2008). Competition or monopoly? Comparing privatization of local public services in the US and Spain. *Public Administration,* 86, 1–13.

Chapter 2
Cost Savings of Contracting Out Refuse Collection in The Netherlands

E. Dijkgraaf and R.H.J.M. Gradus

Abstract This chapter discusses the possible cost savings of contracting out refuse collection in the Netherlands. Our findings indicate that similar to foreign econometric studies cost savings of approximately 15–20% apply to the Netherlands. Moreover, compared with the existing literature we show that different production technologies apply to internal municipal waste collection units and external refuse collection firms. Different cost functions have to be estimated for the sub-samples. Though significant cost savings exist on contracting out waste collection, households will not experience these cost savings on a one to one basis. Private refuse collection firms must pay VAT while public entities are exempted. Thus, the fiscal system hinders a more pronounced role for private refuse collection firms.

Keywords Collection · cost estimation · chow stability test · pooling · VAT

2.1 Introduction

Contracting out tasks like refuse collection, building cleaning, catering and vehicle maintenance has become an important measure to improve efficiency within the public sector. There is much evidence that contracting out certain public services can imply an efficient provision of services well adapted to needs and reduces the costs to tax payers. In an overview article Domberger and Jensen (1997) show that contracting out suggests cost savings in order of twenty percent without sacrificing the quality of service provided for a number of government services.

✉ E. Dijkgraaf
SEOR-ECRi, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands
e-mail: dijkgraaf@few.eur.nl

R.H.J.M. Gradus
Faculty of Economics and Business Administration, VU University Amsterdam, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands
e-mail: rgradus@feweb.vu.nl

E. Dijkgraaf, R.H.J.M. Gradus (eds.), *The Waste Market*,

In this chapter, we focus on the effects of contracting out refuse collection. A number of empirical studies are published on the effects of different institutional forms on performance in the waste collection market. The studies estimate the effects of private collection (or contracting out) by estimating a cost function. Generally, these studies show considerable cost savings, if refuse collection is contracted out.[1]

Kitchen (1976) estimates a cost decrease of $ 2.23 per capita when private firms collect household waste with data for 48 Canadian municipalities. Observations of 340 public and private firms in the USA, Stevens (1978) indicate a cost decrease of 7% to 30% due to contracting out. The magnitude of the effect depends on the size of the municipality. Pommorehne and Frey (1977) study refuse collection in Switzerland and again the private sector comes up with lower costs that amounted to 20%. Domberger et al. (1986) published a study on the effects of contracting out household refuse collection in the United Kingdom. Making use of a data set with 610 observations for 305 municipalities, they concluded that there are cost savings of 22% for contracting out to private companies and 17% for contracting in-house. Szymanski and Wilkins (1993) and Szymanski (1996) have confirmed the results, based on an extension (in years) of this database. Ohlsson (1998) reports comparable efficiency gains of contracting out for Sweden. Bosch, Predaja, and Suárez-Pandiello (2000) analyze Spanish data for 73 municipalities in Catalonia. They pointed out that the framework for which the service is provided is more relevant than the public private dichotomy. In a recent contribution Reeves and Barrow (2000) pointed out cost savings of around 45% in Ireland.

Though studies are performed for different countries, a study in the Netherlands is missing. We try to fill the gap and show that results of other studies are confirmed if we use comparable estimation techniques. Furthermore, we extend these studies in two directions. First, with the exception of Stevens (1978) all cited studies pool observations of waste collection units with respect to institutional forms to estimate the effects of contracting out. With this pooled data set a cost function is estimated and the coefficient of the included institutional dummy reveals the effect of different institutional forms. It is, however, questionable if this pooling is acceptable. Chow (1960) states that: 'Often there is no economic rationale in assuming that two relationships are completely the same' (p. 591). In other areas of economics Chow stability tests are used frequently, see e.g. Apergis, Papanastasiou, and Velentzas (1997), Lai (1994) and Loomis (1989). The most important application of the Chow stability test is to check for the Lucas critique in time-series. However, checking for different types of models with cross-sectional databases can be important as well.

---

[1] Some studies only compare the average cost for private versus public collection on the basis of ratio analysis, see e.g. Savas (1977, 1981) and McDavid (1985) or Data Envelopment Analysis, see e.g. Cubbin, Domberger, and Meadowcroft (1987). However, these methods fail to account for the effects in changes of other variables. By estimating a cost function, institutional effects but also other factors as the frequency of collection and density of the infrastructure can be taken into account. Therefore, we rely on this method in this chapter.

A priori it is not sure whether external refuse collection firms (outside firms) apply the same waste collection technology as internal municipal waste collection units (inside firms). Outside firms handle the collection process from a different perspective while organizational goals also differ. Moreover, differences in municipality size can lead to different collection techniques. For instance, bigger cities have more opportunities to make use of scale economies. If production techniques are not identical, pooling can lead to biased coefficients. Therefore, if pooling is not justified, different cost functions have to be estimated for each sub-sample. The omission of the checks on the validity of pooling in the mentioned studies may lead to biased estimated effects of contracting out on performance. From a policy perspective, it is important that estimations of possible cost savings are accurate.

Secondly, compared with previous studies more emphasis is put on the fiscal system. Due to the Dutch fiscal system there is a disincentive for contracting out. Even though we can estimate significant cost savings when waste collection is contracted out, households will not experience these cost savings on a one to one basis. In the Netherlands private collection firms have to pay VAT while public firms are exempt. Countries such as the United Kingdom and Denmark have a compensating system, in that local authorities are tax-neutral toward contracting outside or inside. Thus, the current fiscal system in the Netherlands renounces the role for private collection firms.

2.2 Effects of Tendering: Estimations for The Netherlands

Although many foreign econometric studies on effects of contracting out refuse collection have been published, such estimations are not available in the Netherlands. This section is an attempt to fill this gap by estimating a cost function, making use of a representative data set for Dutch municipalities. To make the results comparable the applied technique in this section corresponds with the studies cited in the previous section. The Chow stability test is applied in the next section.

2.2.1 Method

On the basis of previous research (see e.g. Stevens, 1978) the following standard equation is estimated:[2]

$$C = \alpha_1 Q + \alpha_2 I + \alpha_3 D + \alpha_4 F + \alpha_5 G + \alpha_6 P + \alpha_7 V + \alpha_8 O + \alpha_9 \qquad (2.1)$$

The driving forces behind the (logarithm of) total collection cost per municipality (C), include a number of variables.[3] First, the number of pick-up points (Q) is expected to determine part of the total cost. This reflects on the cost, which a collection

[2] Based on a Cobb-Douglas production technique and minimization of a total cost function.

[3] No price variables for the different inputs are included, because no reason exists ex ante why factor prices would differ between municipalities.

unit has to make by the number of stops. Secondly, the time spent at the pick-up stop (more bags or bins) can determine total cost. The number of inhabitants per pick-up point (I) approximates these costs. A third driving force is the time to arrive at the different pick-up points. The density variable, surface per pick-up point (D), approximates this. Fourth, the frequency of collection (F) is expected to have influence on total collection cost and is therefore included. Furthermore, the percentage of glass (G), paper (P) and vegetable, fruit and garden waste (V) separately collected is included in the estimations.

Furthermore, we include a dummy for the institutional form in which waste is collected (O). Main difference of the institutional form is whether waste is collected by the municipality itself or outside. Within this category we can discriminate between two types on the basis of ownership, i.e. public and private. Public outside collectors are a combination of municipalities for which waste is collected by an other municipality and municipalities that formed an independent public organization. Given the division of institutional forms, the basic model is tested whether the ownership of the outside collection service does matter.

Expected signs are positive for the number of pick-up points, inhabitants per pick-up point, surface per pick-up point and collection frequency and negative for the institutional dummy's, while signs of the coefficients for the percentage collected glass, paper and vegetable, fruit and garden waste are undetermined a priori.

2.2.2 Data

To collect data 120 municipalities were approached in the period November 1996-April 1997. These municipalities were selected at random from 646 Dutch municipalities. A total of 85 municipalities have responded to this inquiry, a response rate of 71%.[4] The 85 municipalities responded to an inquiry on the collection of waste in 1996. The resulting database was checked on consistency of answers and the reliability was checked by spot checks on key answers.

Of the 85 municipalities 41 collect their waste not inside, but trough an outside organization (see Table 2.1). Of the 41 outside firms, 13 were public independent organizations while 3 municipalities collect the waste through an other municipality. The remaining 25 municipalities collected the waste through a private collection firm.

Total cost per municipality is measured by multiplying the refuse collection rate(s) by the total number of households. Total cost is diminished by handling cost by multiplying cost per ton with tons recycled (glass and paper), composted vegetable, fruit and garden waste) and disposed (incineration and dumping).

[4] In 1996 four municipalities were absorbed by another, 31 municipalities did not participate in this inquiry.

Table 2.1 Data description

	Average	Maximum	Minimum	St.dev.
Total cost (million euro)	1.6	20.5	0.1	2.5
Pick-up points (number)	16,386	267,000	400	3,0618
Inhabitants (per pick-up point)	4.0	64.7	1.6	8.1
Density (km^2 per pick-up point)	11	93	1	15
Frequency (>1 per week, dummy)	0.19	1.00	0.00	0.39
Glass (%)	3.2	11.1	0.0	3.0
Paper (%)	6.6	29.7	0.0	7.5
VFG (%)[a]	28.4	47.4	0.0	9.9
Outside collection (dummy)	0.48	1.00	0.00	0.50
Private outside collection (dummy)	0.29	1.00	0.00	0.46
Public outside collection (dummy)	0.19	1.00	0.00	0.39

Note: [a] VFG = vegetable, fruit and garden waste

2.2.3 Fiscal Aspects

A lot of attention has been drawn to the distortionary aspects of taxation for all kind of commodities (see Atkinson and Stiglitz, 1980). For the central question in this chapter taxation can also be crucial. The fiscal regime distorts the decision process in the Netherlands with respect to public versus private waste collection (see Wassenaar, 2001). Private refuse collection is faced with a VAT rate of 19%, while public organizations are exempted from VAT. Therefore, a municipality in the Netherlands is biased toward inside production, because then refuse collection is exempted from VAT.

A possibility to resolve this inequality could be to assess public refuse collection as a business activity and thus tax them with VAT. This policy has been introduced to public companies such as telecommunications. However, taxing refuse collection by municipalities is not allowed according to EU laws. The other extreme, introducing a VAT exemption for enterprises is also not allowed.

The ministry of Finance has been working on a system to create a VAT compensation fund for public waste collectors (Wassenaar and Gradus, 2001). In line with a system already working in United Kingdom, all VAT a municipality has to pay will be refunded. In that case a municipality that decides to contract out the waste collection to a VAT liable firm will be compensated for the VAT the firm has to pay. Thus, contracting out decisions by a municipality are no longer distorted by the VAT difference between public and private firms.

The difference in fiscal treatment cannot be neglected for the Dutch data set for a proper analysis. The municipality cost for private companies are 19% higher compared to public companies. However, the costs for a private company are 19% lower and in this respect the cost data are corrected.[5] Thus, the VAT component is subtracted from the total cost for private firms.

[5] A the cost data are for the fiscal year 1996, the VAT correction is based on the tariff of that year (17.5%).

2.2.4 Results

Results for the basis model are presented in the first column of Table 2.2. The F-statistic shows that the equation is significant, while the high (adjusted) R^2 indicate that the explained variation is high. All coefficients have the expected sign. T-statistics are not corrected for heteroscedasticity as the White test (White, 1980) could not reject the homoscedasticity hypothesis for all estimations with 95% confidence.

The number of pick-up points has a significant impact on the total collection cost. A Wald test of coefficient restrictions (Pindyck and Rubinfeld, 1991) does not falsify the constant returns to scale hypothesis. This result confirms earlier results from Reeves and Barrow (2000), Collins and Downes (1977) and Hirsch (1965), while Stevens (1978) found also constant returns to scale for the large cities. Decreasing returns to scale were found by Bosch, Predaja, and Suárez-Pandiello (2000) and Domberger et al. (1986) and increasing returns to scale in Szymanski and Wilkins (1993), but coefficients were very close to one. Kitchen's (1976) inverted U-shaped average cost curve result was not confirmed since inclusion of a quadratic term was falsified with an F-test on 95% confidence.

Table 2.2 Estimation results cost functions

		Dummy for outside collection	Dummy for outside and private outside collection
Pick-up points	ln	1.052	1.052
		(20.90)	(20.81)
Inhabitants per point	ln	1.004	1.007
		(12.34)	(12.29)
Density (km^2 per point)	ln	0.009	0.010
		(0.23)	(0.24)
Frequency	dummy	0.174	0.177
		(2.07)	(2.10)
Glass	%	0.019	0.018
		(1.41)	(1.36)
Paper	%	−0.008	−0.007
		(−1.40)	(−1.25)
VFG	%	−0.010	−0.010
		(−2.26)	(−2.06)
Private and public outside	dummy	−0.163	−0.134
		(−2.18)	(−1.44)
Private outside	dummy	−	−0.051
			(−0.50)
Constant		4.13	4.10
		(6.96)	(6.84)
R^2		0.93	0.93
F-value		132.30	116.48
Log likelihood		−11.36	−11.22
White (prob. Homoscedasticity)		0.41	0.40
Number of observations		85	85

Note: Below coefficients are t-statistics. VFG = vegetable, fruit and garden waste