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Efficiency Effects of Privatising Refuse Collection: Be Careful and Alternatives Present

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

** Erasmus School of Economics, Erasmus University Rotterdam, and Tinbergen Institute;*
*** Faculty of Economics and Business Administration, VU University Amsterdam, and Tinbergen Institute.*

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Efficiency effects of privatising refuse collection: be careful and alternatives present

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E. Dijkgraaf[*] and R.H.J.M. Gradus[**]

Abstract: For refuse collection, we estimate the cost effects of different institutional modes using panel data for almost all Dutch municipalities between 1998 and 2010. The modes we consider are private contracts, intermunicipal cooperation, public provision and own collection. For private companies, the cost advantage is substantially smaller and non-significant if municipal fixed effects are included. The cost advantage of intermunicipal cooperation is larger in this case than that of privatisation. Moreover, if yearly mode dummies and mode duration are also included, we show that for 2004, 2005 and 2006 a large cost increase is visible for privatisation. Which mode offers the most cost-saving opportunity depends strongly on the year and the mode duration. For private contracts, the duration effects lead to lower costs; for municipal cooperation and public provision, there are extra costs to begin with, which disappear after 5 or 6 years.

Keywords: Waste collection, private firms, contracting out, fixed effects

JEL codes: D43, L33, R51

[*] Rotterdam School of Economics, Erasmus University Rotterdam and Tinbergen Institute, Room H 8-21, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands; Email: dijkgraaf@ese.eur.nl

[**] VU University Amsterdam and Tinbergen Institute; Email: rgradus@xs4all.nl

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1. Introduction

One of the promises of privatisation is that it offers efficiency gains and reduces the costs of public delivery. In the early literature, there was indeed evidence that private production of public services such as refuse collection can imply an efficient provision of services well adapted to needs and a reduction in the costs to the taxpayer. In an overview article, Domberger and Jensen (1997) show that private production suggests cost savings of the order of 20% without sacrificing the quality of service provided for a number of government services. However, the current evidence for cost savings from private delivery is more mixed. In a recent overview article, Bel et al. (2010) conduct a meta-regression analysis mostly on the refuse collection literature and show that there is no unambiguous evidence for obtaining significant cost savings from private production. Interestingly, if they control for small sample size, the results are even weaker.

Some of the literature has shown that competitive tendering is more important than the ownership issue. For example, Domberger et al. (1986) and Dijkgraaf and Gradus (2003) find that tendering is cheaper than in-house production, but when contracts are awarded by tender, public and private providers do not show significant differences in costs. Benito et al. (2010) conclude for refuse collection in Spain that in-house management is more efficient than out-house management. In addition, the literature has increasingly turned its attention to factors that might undermine savings from contracting out, such as hefty transaction costs (Brown and Potoski, 2003, 2005) and market concentration (Bel and Costas, 2006; Dijkgraaf and Gradus, 2007). However, most of these studies are based on small sample sizes and the explanatory power of these empirical studies is in general low.

In this paper, however, we can rely on a very large data set. This makes it possible to test two important issues, which are not commonly studied in the literature: the dynamics of efficiency in combination with the correction for municipal-specific effects.

The literature suggests that the effects of contracting out and privatisation might be time dependent. As market circumstances change and providers react to each other, an effect found in a certain year

need not guide us to the long-term effect. It is possible, for instance, that in a certain period with massive competition private providers have the lowest costs, while after a shake-out their performance deteriorates (Dijkgraaf and Gradus, 2008). Furthermore, the effects for municipalities might be different when they use a certain mode of provision for a longer time. Dependent on the contract, the question is: who profits from efficiency improvements during the contract and who pays for transaction costs? As private provision necessitates more formal contracts than intermunicipal cooperation or public provision, it could be the case that the development of costs during the contract is different between provision modes. Also, Bel et al. (2010) find that the early literature might overestimate the effects of private provision, as newer studies find less profitable effects. They base this conclusion on comparing the findings of different papers. As these papers are based on very different data sets and methodologies, it is unclear what the exact dynamic effects are. As we have panel data for the period 1998–2010, we can test directly and explicitly whether effects are robust over time.

When a cost function is estimated, it is essential that we correct for exogenous differences between municipalities. Nearly all studies therefore include explicit variables to correct, for instance, for differences in size and the density of the network. Wassenaar et al. (2010) show indeed that other motives, such as the concern for local employment, the stability of service provision or building a new Town Hall, are important as well. However, it is nearly impossible to have explicit variables for all relevant differences, as these are often not observable. The solution is, of course, to include fixed effects. Our panel data set makes this possible, which is interesting, as nearly no studies have a large enough data set to do this.

Using a recent overview of the literature by Bel et al. (2010), we are able to identify only two studies that used large panel data (Szymanski and Wilkins, 1993; Szymanski, 1996). These studies are based on UK data and include municipality fixed effects. However, the situation in the UK is influenced by the fact that competitive tendering has been compulsory since 1988. This means that the UK experience is not comparable to that in any other country, as in no other country is compulsory

competitive tendering present. In other countries, including fixed effects might have a larger influence on the results. Still, the two papers on the UK find that including fixed effects influences the estimation results. The panel estimations with fixed effects imply that using competitive tendering has somewhat larger effects than contracting out the service, although the authors recognise that, given the lack of stability between models, this is at best a tentative conclusion.

So, there is no study analysing dynamic effects of the provision mode while correcting for municipal fixed effects. We try to fill the gap by using panel data for almost all Dutch municipalities between 1998 and 2010. Interestingly, we find large differences if these municipal fixed effects are included.[1]

The paper is structured as follows. Section 2 describes the methodology and the data. The main results are presented in Section 3, focusing on the difference between the model with and without municipal fixed effects. In Section 4, the results including yearly dummies and duration effects are presented. Section 5 offers some concluding remarks.

2. Methodology and data

We answer our research question by estimating the following cost function:

$$\ln TC = f(\ln Q, \ln I, \ln S, O_O, O_S, O_I, O_P, a_j, b_t),$$

where the O_i are dummies and a_j and b_t are fixed effects.

Comparison of total cost (TC) between municipalities is only possible when a correction is made for all relevant differences in exogenous factors. The factors we use follow directly from the literature that

[1] Using Dutch municipality data, Allers and Hoeben (2010) find that the effects of garbage pricing on the quantity of waste collected are much smaller when municipal fixed effects are included than without fixed effects.

estimates cost functions for waste collection (for the Netherlands, see Dijkgraaf and Gradus (2003, 2007)). Total costs will change:[2,3]

- if the number of stops made by the collection vehicle increases (Q is the number of pick-up points, measured as the number of households);
- if the time spent at each pick-up stop increases (more bags or bins) (I is the number of inhabitants per pick-up point);
- if the time to arrive at the different pick-up points increases (S is the area served per pick-up point);
- if the institutional form in which waste is collected changes (O_S is a dummy with value 1 for municipalities that collect waste in cooperation with other (neighbouring) municipalities, O_I is a dummy with value 1 for municipalities that use a public company, O_P is a dummy with value 1 for municipalities that use a private waste-collection firm and O_O is a dummy with value 1 for municipalities that collect waste themselves);
- as the time-invariant regional fixed effects (a_j) change; therefore we include fixed effects at the provincial or municipal level;[4]
- as the time fixed effects (b_t) change; therefore we include a fixed effect for each year.[4]

The results of this model are presented in Section 3. In Section 4, we investigate the consequences if circumstances change over time. It might be argued that private collection, for instance, will be cheaper in years when there is more competition in the market. Market circumstances will be different for different years. Thus, the effects of institutional forms might vary with respect to time. We test whether the effect of institutional form is time-robust by multiplying by year dummies. In addition, we

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[2] Price variables for the different inputs are not included as there is no ex ante reason for factor prices to differ between municipalities. Wage bargaining takes place at a national level.

[3] In Dijkgraaf and Gradus (2008), we include unit-based pricing systems based on volume, frequency, number of bags and weight. However, the impact of these variables doubles when using the municipal fixed effects, as sensitivity analysis shows.

[4] For convenience, we do not present these dummies in the tables. They are available on request.

investigate the effects if institutional forms are used for longer periods. It might be argued that if an institutional form is used longer – for instance, because municipalities become locked in or are less keen to search for alternatives – providers might exploit this by increasing costs. On the other hand, it might be the case that more experience leads to lower costs if municipalities are able to gain financially from efficiency improvements. We test this by including variables for mode duration (OD_S, OD_I and OD_P measure the number of years the institutional form is used by each municipality).

Table 1. Descriptive statistics

Variable	Unit	Mean	Max.	Min.	St. dev.
Collection costs (TC)	Euro per household	234	379	107	35
Number of households (Q)	Total	14,211	422,073	400	28,236
Household size (I)	People per household	2.50	3.70	1.70	0.20
Density (S)	Ha per household	1.12	92.45	0.02	3.33
Collection by:					
- neighbour/cooperation (O_S)	Proportion by number of municipalities	0.19	1	0	0.39
	Proportion by number of inhabitants[1]	0.13	213,809	2,528	21,401
- public company (O_I)	Proportion by number of municipalities	0.21	1	0	0.41
	Proportion by number of inhabitants[1]	0.26	488,553	942	51,774
- private company (O_P)	Proportion by number of municipalities	0.37	1	0	0.48
	Proportion by number of inhabitants[1]	0.23	209,699	1,181	17,883
- own municipality (O_O)	Proportion by number of municipalities	0.23	1	0	0.42
	Proportion by number of inhabitants[1]	0.38	767,457	946	95,810
Duration of contract for:					
- neighbour/cooperation (OD_S)	Years	4.11	13	1	3.39
- public company (OD_I)	Years	3.14	13	1	2.69
- private company (OD_P)	Years	5.12	13	1	3.66
Observations		5,886			

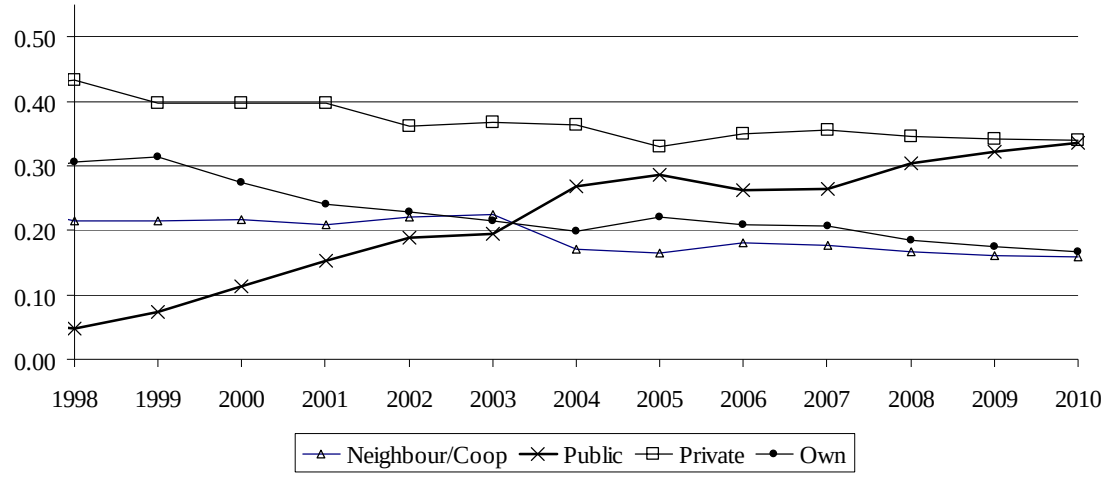
1. In the columns Max., Min. and St.dev. the number of inhabitants are given.

Data for Q, I and S are from the Dutch Bureau of Statistics (CBS). Institutional data on waste collection come from the Dutch Waste Management Council (AOO). We have data for 1998–2010.

TC is calculated for each municipality by multiplying the average cost per household by the number of households.[5] TC is in real terms as we corrected for price developments on the basis of the index of consumer prices. We have an unbalanced panel with 5,886 observations on 548 municipalities.[6] Table 1 gives the descriptive statistics.

Dutch municipalities have a legal obligation to provide a waste-collection infrastructure for municipal waste, but they are free to choose whether to carry out this task themselves or to contract out waste collection to outside firms (public or private). Of all observations, 37% represents contracting out waste collection to a private firm and 21% to a public firm (see Table 1). It should be noticed that a public firm operates under commercial law, whereas the shares are publicly owned by municipalities. A third group of observations (19%) represents collection via a municipal service in cooperation with neighbouring municipalities. In the Netherlands, municipal cooperation means maintaining public production. The remaining observations (23%) represent collection by municipalities themselves.

Figure 1. Market shares 1998–2010, measured by number of municipalities



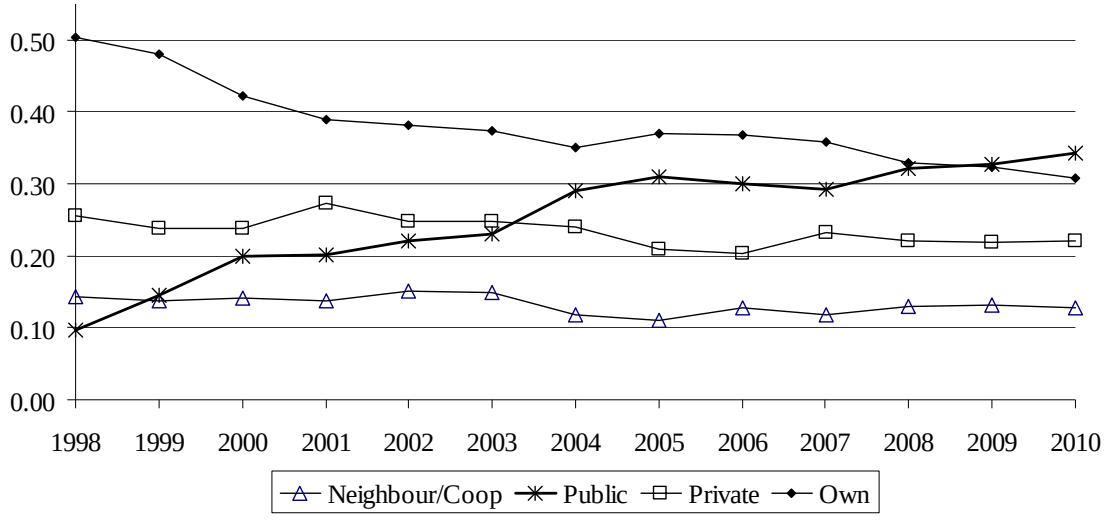
[5] The AOO presents figures on actual tariffs for collecting and disposing of garbage and on the extent to which these tariffs cover total costs. If actual tariffs do not cover total costs, we use coverage factors (provided by the AOO) to calculate cost-covering tariffs.

[6] The number of municipalities decreased from 548 in 1998 to 431 in 2010. For 1998, data are available on 72% of the municipalities. From 2001, data on almost all municipalities (more than 95%) are available. For some small merged municipalities, data are only available in a couple of years.

Interestingly, the market share of public firms increases substantially from 5% in 1998 to 33% in 2010 (see Figure 1). The share of municipalities collecting waste themselves decreases from 31% in 1998 to 17% in 2010. In 1998, 43% of municipalities used private firms, while this figure is 34% in 2010. This is at least partly the result of the merging of small villages, as private collectors are especially active in these villages. However, these patterns underline the question of whether contracting out to private waste collectors is beneficial in the long term, as contracting out to public collectors is increasingly a preferred choice for municipalities in the Netherlands.

Figure 2 shows market shares weighted by the number of inhabitants for 1998–2010. This measure of market share is much smaller for private contractors and much larger for own collection than the shares in Figure 1. This implies that own collection is applied more in large cities and private collectors are used more in small municipalities. Public companies are more active in large cities as well and municipal cooperation is more usual in small municipalities, but the differences are less pronounced.

Figure 2. Market shares 1998–2010, measured by number of municipalities weighted by inhabitants



3. Results

Table 2 shows the estimation results for the cost function. In this section, we include two

specifications (one with provincial fixed effects and one with municipal fixed effects). For all specifications, we include a constant, the number of pick-up points (measured by the number of households, Q), the household size (I) and the density (S).[7]

Table 2. Effects on waste-collection costs: total period dummies

	Provincial fixed effects	Municipal fixed effects
Collection by neighbour/cooperation	0.0126**	–0.0156*
Collection by public company	0.0153**	0.0074
Collection by private company	–0.0473***	–0.0138
Number of households	0.997***	0.957***
Household size	–0.151***	0.280*
Density	–0.001	0.006
Constant	1.027***	1.015***
Municipal fixed effects	No	Yes
Provincial fixed effects	Yes	No
Year fixed effects	Yes	Yes
R^2	0.9746	0.9875
Observations	5,886	5,886

Note: */**/*** means significant at the 10%/5%/1% level. Standard errors are White corrected.

Thus the first model includes only total period dummies for municipalities with collection by a neighbour or cooperation, by a public company or by a private company. In this model, municipalities that collect the waste themselves are the benchmark. The second model includes these dummies, but also includes far more detailed municipal fixed effects instead of provincial fixed effects.

According to the first model, private collection is 12% cheaper than collection by municipalities themselves.[8] This is consistent with results reported by Dijkgraaf and Gradus (2003, 2007). Collection

[7] All estimations are based on pooled least squares. A unit root is rejected at 1% for collection costs with all available tests (Levin, Lin and Chu; Breitung t-stat; Im Pesaran and Shin W-stat; ADF-Fisher and PP-Fisher). All standard errors are White corrected (cross-section specific) as homoscedasticity was rejected with the Breusch–Pagan test for all models at the 1% level.

[8] As the estimations are in logs, the effect can be calculated using e^x–1. Note that this effect has to be multiplied by 2.5 as collection costs are on average 40% of total costs.

by a public firm is 4% more expensive than collection by municipalities. This is comparable to earlier results (see Dijkgraaf and Gradus (2008, p. 117)). Moreover, the difference between collection via intermunicipal cooperation and collection by the municipality itself is small, at +3%. In addition, the number of pick-up points has a significant effect on total costs and the estimation indicates constant returns to scale. Remarkably, household size has a negative significant effect on total costs. For density, the effect is not significant.

The second model shows that the cost advantages of the different institutional forms are not robust if they are compared with a model with municipal fixed effects. For private companies, the cost advantage becomes insignificant and almost disappears, from 12% without these fixed effects to 3.5% with them. Thus, privatisation effects are substantially smaller if municipal fixed effects are taken into account. Interestingly, the cost advantage of intermunicipal cooperation is now, at 4%, larger than that for a private company. This is line with Bel and Costas (2006), where intermunicipal cooperation is found to be the best alternative to privatisation. In addition, our result is only significant at the 10% level. However, this is not in line with the empirical analysis for Norway (see Sørensen (2007)), that gives indications that municipal cooperations suffer from transaction and agency costs as several political authorities are involved. Although Dutch municipal cooperation is in general a multi-government body, for refuse collection it seems to come with few transaction costs as on a-day-to-day basis, civil servants run this public unit (see Bel et al. (2010)). For public firms, no significant effect is found. In addition, the estimate for the number of pick-up points indicates, in line with the literature, increasing returns to scale, which suggests that especially small municipalities can make some use of economies of scale (see, for example, Stevens (1978)). Moreover, as expected, household size has a positive and significant effect on total costs.

4. Model with year effects of institutional mode and mode duration effects

In this section, we include year dummies for the institutional modes and the mode duration effects. Hereby, we use a cubic function as these effects might be non-linear. Table 3 contains the estimated effects. For municipal cooperation and public provision, at the beginning a longer duration for the production mode results in lower efficiency. This indicates that there are transaction costs, although learning effects may compensate for them later on.

Based on the estimations in Table 3, Figure 3 presents the effect of mode duration on cost savings for the different modes of production. We only include the effects if they are significant at 10% or less. For private contracts, a cost advantage is available for the first seven years. But from the eighth year onwards, the effects are no longer significant. Interestingly, this has some similarities with Szymanski (1996), who investigates time patterns after competitive tendering of refuse collection. He finds a step fall in costs shortly after introducing competitive tendering and an increase in expenditure some periods later. This can indicate hold-up effects, although this is a topic for further investigation. The result gives at least some indication that the cost advantage effects of long contracts are less favourable. For municipal cooperation and public provision, the duration effects are different from those for private production. At the beginning, there are extra costs, which disappear after 5 or 6 years.

Figure 4 presents the effects of mode of production over time, based on the results of Table 3. For private collection, notice that the pattern over time is not stable. The privatisation effects at the end of the last century seem to be in line with the literature. Remarkably, for 2004, 2005 and 2006 a large cost-increasing change is visible for private companies. In these years, privatisation leads to higher costs. It is possible that this has something to do with the introduction of the VAT compensation fund in that period. In earlier years, municipalities that contracted out to private companies had a tax disadvantage as they had to pay VAT. The government introduced a compensation fund in 2003 and municipalities were then compensated for the VAT increase. The estimation results are in line with the

Table 3. Effects on waste-collection costs: institutional form by year and mode duration

Collection by neighbour/cooperation					
- mode duration	0.0344***				
- mode duration squared	–0.0064***				
- mode duration cubed	0.0003***				
Collection by public company					
- mode duration	0.0203***				
- mode duration squared	–0.0034***				
- mode duration cubed	0.0001***				
Collection by private company					
- mode duration	–0.0107*				
- mode duration squared	0.0013				
- mode duration cubed	–0.0001				
Collection by neighbour/cooperation	1998	1999	2000	2001	2002
- year dummies 1998–2002	–0.042***	–0.072***	–0.045***	–0.048***	–0.034***
	2003	2004	2005	2006	2007
- year dummies 2003–2007	–0.029***	–0.013	–0.013	–0.029**	–0.029**
	2008	2009	2010		
- year dummies 2008–2010	–0.043***	–0.059***	–0.080***		
Collection by public company	1998	1999	2000	2001	2002
- year dummies 1998–2002	–0.017	–0.002	–0.043***	–0.055***	–0.049***
	2003	2004	2005	2006	2007
- year dummies 2003–2007	–0.046***	–0.025**	–0.015	–0.032**	–0.019
	2008	2009	2010		
- year dummies 2008–2010	–0.033*	–0.031	–0.008		
Collection by private company	1998	1999	2000	2001	2002
- year dummies 1998–2002	–0.042**	–0.033**	–0.024*	–0.022**	–0.016*
	2003	2004	2005	2006	2007
- year dummies 2003–2007	–0.021**	0.041***	0.035***	0.016	–0.022
	2008	2009	2010		
- year dummies 2008–2010	–0.036	–0.069**	–0.046*		
Number of households	0.951***				
Household size	0.238				
Density	0.009				
Constant	1.130***				
Municipal fixed effects	Yes				
Year fixed effects	Yes				
R^2	0.9879				
Observations	5,886				

Note: */**/*** means significant at the 10%/5%/1% level. Standard errors are White corrected.

Figure 3. Effects of mode duration (% of total costs)

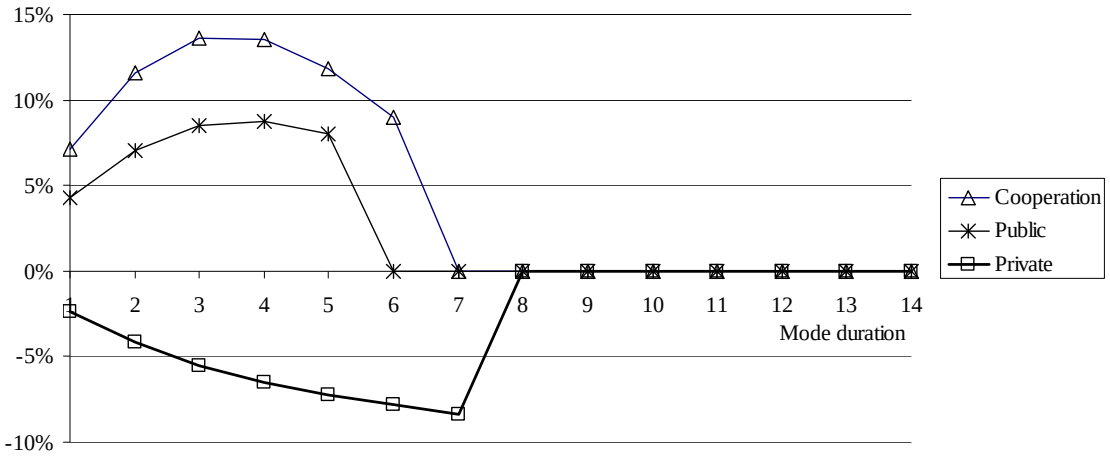
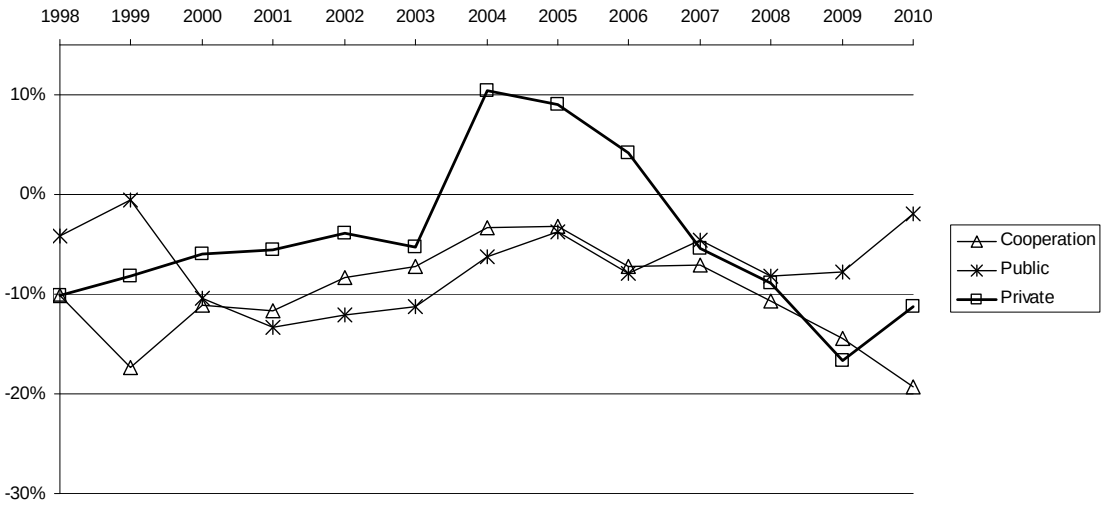


Figure 4. Effects of mode of production over time (% of total costs)



hypothesis that private companies take advantage of this compensation. This is possible if there is not enough competition in the market. However, the figures for the years after 2006 show that private companies were forced to decrease costs again to competitive levels. For recent years, the privatisation effects are becoming negative and significant and again in line with the earlier results. The recent increase in costs for public companies is notable, as is the recent trend in decreasing cost for cooperating municipalities.

To get the total effects on costs, we have to sum the year dummies for the institutional mode and the duration effects. We present these effects in Table 4 for mode durations of 5, 10 and 13 years (the maximum in our data set). Insignificant coefficients at more than 10% are assumed to be zero.

Table 4. Total effects on costs by year and mode duration (% of total costs)

	Mode duration: 5 years			Mode duration: 10 years			Mode duration: 13 years		
Starting year	Cooperation	Public	Private	Cooperation	Public	Private	Cooperation	Public	Private
1998	1	7	**–15**	–3	4	**–14**	–5	3	**–13**
1999	–6	7	**–13**	–11	4	**–12**	**–13**	3	–11
2000	0	–3	**–11**	–4	–7	**–10**	–6	–8	**–9**
2001	0	–6	**–11**	–5	**–10**	**–10**	–7	**–11**	–9
2002	3	–5	**–9**	–2	**–8**	**–8**	–4	**–9**	–7
2003	4	–4	**–10**	–1	–8	**–9**	–2	**–9**	–8
2004	12	**1**	5	7	**–3**	6	5	**–4**	7
2005	12	7	**4**	7	**4**	5	5	**3**	6
2006	4	–1	**–5**	–1	**–4**	**–4**	–2	**–5**	–3
2007	4	7	**–5**	0	4	**–4**	–2	3	**–3**
2008	1	–1	**–5**	**–4**	**–4**	**–4**	**–6**	**–6**	–3
2009	–3	7	**–22**	–8	4	**–21**	–10	3	**–20**
2010	–8	7	**–16**	–13	4	**–15**	**–15**	3	–14

Note: Numbers in bold are the least-cost options each year.

Table 4 shows that the cost advantage is largest for private provision if the mode duration is short. For a 5-year contract, only in 2004 did public companies have lower costs. In recent years private provision wins again. For longer mode durations, the picture changes. If we look at municipalities with 10 years in the same mode, public provision already becomes competitive in 2001 and is preferred until 2007 (with the exception of 2003). This remains the case if we look at a mode duration of 13 years (without the exception). But now cooperation becomes the preferred option in some years

towards the end of the period. For all mode durations, the difference between modes is smaller in 2005–2008. But very recently, for 13-year contracts, cooperation even becomes the best option (although the difference with private provision is only 1%).

As there is a pattern in practice that Dutch municipalities increasingly prefer public collection, our results suggest that this must currently be motivated by considerations other than costs. Earlier work shows that in provinces with a high concentration of private firms, public firms can be useful to stimulate competition (see Dijkgraaf and Gradus (2007)). The current results indicate that cooperation could now be the thorn in the side of private providers.

5. Conclusions and discussion

For refuse collection, we estimate the cost effects of different institutional modes using panel data for almost all Dutch municipalities between 1998 and 2010. Interestingly, we show large differences between omitting and including municipal fixed effects. For private companies, the cost advantage is substantially smaller and non-significant if municipal fixed effects are taken into account. As the current literature does not include fixed effects at the municipal level, one should be sceptical about the reported effects of privatisation. In addition, the cost advantage of intermunicipal cooperation is now larger than that for privatisation, if municipal fixed effects are taken into account. So, when dealing with increasing returns to scale, cooperation can be an alternative as well.

If year effects of institutional mode and duration effects are taken into account, some interesting conclusions can also be drawn. First, remarkably, for 2004, 2005 and 2006 a large cost increase is visible for privatisation. Second, for private contracts, the duration effects lead to lower costs, so this seems to be an indication that start-up costs are included in the contract and that municipalities profit from efficiency improvements. For municipal cooperation and public provision, there are extra costs for 5 or 6 years, which then disappear. These start-up costs will be paid directly by the municipality's citizens. Third, in most years, private provision is the most cost-saving opportunity. Nevertheless, for

longer durations, public provision is the most cost-saving opportunity in 2001–2006 and this seems to be the case for municipal cooperation in 2010. This indicates that the waste-collection market is dynamic. In some years, private providers seem to have market power, but other modes are reacting and able to provide a cost-effective alternative. This also leads to the conclusion that results for one or only a few years might not reveal which option is preferred in the long term. Studies based on one or only a few years, which are dominant in the literature, might mislead policy-makers if contract modes react to each other. Such studies might reveal ex post realisation of efficiency improvements, but this does not necessarily tell the whole story if one is interested in ex ante expectations. More research on the dynamics of waste markets is necessary to open the black box that governs these dynamics. Only when this black box is opened might clear ex ante expectations be provided.

The effect found in this paper, that cooperation is increasingly becoming a sound alternative to private provision, is based on very recent evidence. It will be interesting to test how this mode of provision develops compared with other modes, when 2011 and 2012 data become available.

References

Allers, M., C. Hoeben, 2010, 'Effects of unit-based garbage pricing: a differences-in-differences approach', *Environmental Resource Economics* **45** 405–428.

Bel, G., A. Costas, 2006, 'Do public sector reforms get rusty? An empirical analysis on privatization of solid waste collection', *Journal of Policy Reform* **9** 1–24.

Bel, G., X. Fageda, M. Warner, 2010, 'Is private production of public services cheaper than public production? A meta-regression analysis of solid waste and water services', *Journal of Policy Analysis and Management* **29** 553–577.

Bel, G., E. Dijkgraaf, X. Fageda and R. Gradus, 2010, 'Similar problems, different solutions: comparing refuse collection in the Netherlands and Spain', *Public Administration*, **88** 479-496.

Benito, B., F. Bastida and J. Garcia, 2010, 'Explaining differences in efficiency: an application to Spanish municipalities', *Applied Economics* **42** 515-528.

Brown, T., M. Potoski, 2003, 'Managing contract performance: a transaction costs approach', *Journal of Policy Analysis and Management* **22** 275–297.

Brown, T., M. Potoski, 2005, 'Transaction costs and contracting: the practitioner perspective', *Public Performance & Management Review* **28** 326–351.

Dijkgraaf, E., Gradus, R.H.J.M., 2003, 'Cost savings of contracting out refuse collection', *Empirica* **30** 149–161.

Dijkgraaf, E., Gradus, R.H.J.M., 2007, 'Collusion in the Dutch waste market', *Local Government Studies* **33** 573–588.

Dijkgraaf, E., Gradus, R.H.J.M., 2008, 'Institutional developments in the Dutch waste collection market', *Environment and Planning C: Government & Policy* **26** 110–126.

Domberger, S., P. Jensen, 1997, 'Contracting out by the public sector: theory, evidence, prospects', *Oxford Review of Economic Policy* **13**(4) 67–78.

Domberger, S., S. Meadowcroft, D. Thompson, 1986, 'Competitive tendering and efficiency: the case of refuse collection', *Fiscal Studies* **7**(4) 69–87.

Stevens, B.J., 1978, 'Scale, market structure and the cost of refuse collection', *Review of Economics and Statistics* **60** 438–448.

Sørensen, R.J. 2007, 'Does Public Ownership Impair Efficiency in Norwegian refuse collection", *Public Administration*, **85** 1045-1058.

Szymanski, S., 1996, 'The impact of compulsory competitive tendering on refuse collection services', *Fiscal Studies* **17**(3) 1–19.

Szymanski, S., S. Wilkins, 1993, 'Cheap rubbish? Competitive tendering and contracting out in refuse collection, 1981–88', *Fiscal Studies* **14**(3) 109–130.

Wassenaar, M., R.H.J.M. Gradus, T. Groot, 2010, 'Municipalities' contracting out decisions: an empirical study on motives', *Tinbergen Institute Discussion Paper*, TI 2010-121/3.