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Purchase efficiency in Dutch youth care: locally least squares frontier method applied to municipality data

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Abstract

In this paper, we present an empirical model to analyse the efficiency of youth care by local government, especially with regard to purchasing policies. Locally least squares is applied to data from 352 Dutch municipalities operating in 2021. The outcomes reveal significant variations in the cost efficiency related to purchasing policies among municipalities. For all municipalities, the average cost efficiency is 84%. However, the corresponding standard errors of cost efficiency vary between 2.6% and 14.8% with a mean of 8.6% implying that only a limited number of municipalities are able to achieve efficiency gains with a high degree of certainty. Open House outsourcing and a framework contract without intermediate access are the most influential instruments on cost efficiency. Other features such as the duration of the contract and collaboration with other municipalities appear to have only a modest effect.

Keywords: municipality; productivity; cost efficiency; efficiency determinants; cost function; scaling property; youth care

1. Introduction

Education, law enforcement and health care are important sectors for a well-functioning economy and contribute to social welfare and justice. Because these provisions are often financed by taxes coupled with a lack of market discipline, insight into the performance of these sectors is extremely important (Blank and Lovell, 2000; Blank and Valdmanis, 2019). One way of introducing more economic discipline into these social programmes also include privatisation and contracting. Advocated as ways for increasing performance, the analysis of productivity, efficiency and effectiveness of public services therefore is a topic of interest.

The focus of this productivity research generally is on organisations (or sectors) that are responsible for the production of public services to citizens, such as education (Haelermans and Blank,

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2012; Haelermans et al., 2012), health care (Hollingsworth, 2008), drinking water supply (Goede et al., 2016; Blank et al., 2019; de la Higuera-Molina et al., 2023), waste collection (Pérez-López et al., 2016; Zafra-Gómez et al., 2023), policing (Barton and Barton, 2011) and the immigration and naturalisation services (Niaounakis and van Heezik, 2019).

Developments in assessing the public sector over the past 40 years have been extensive, driven by the development of empirical methods measuring efficiency and productivity. These developments include stochastic frontier analysis (SFA), data envelopment analysis (DEA) and various hybrid approaches like semiparametric and nonparametric methods. These approaches have proved their value through applications in public services (Kumbhakar and Lovell, 2000; Fried et al., 2008; Blank and Valdmanis, 2019; Kumbhakar et al., 2020).

Most of these studies focus on the general efficiency of the services provided and with limited attention to the explanation of efficiency differences. When explanations are given, they are mostly limited to economies of scale, economies of scope, allocation of resources and technical change. There are a number of other aspects that are just as relevant, which can be affected by management on the short term. Examples are human resource management (HRM), information technology (IT) management (Hilhorst et al., 2022) and collaborations (Niaounakis and Blank, 2017).

Another theme that fits in this list regards the way in which the government purchases services in the private sector. Initially, there has been less attention to this, but in recent years, the number of studies on the efficiency effects of the design of outsourcing contracts has increased (Lamothe and Lamothe, 2009; Esteve et al., 2024). This article contributes to the growing literature in this field, focusing on a public service whose efficiency has been relatively underexplored. For unclear reasons, very little efficiency research has been done into youth care so far, in spite of the fact that youth care is relevant in terms of the amount of subsidies involved but perhaps even more in terms of social relevance. An interesting exception can be found with Aguiar et al. (2024) in a recent paper applying a mixed integer programming model for scheduling family interventions. The International Convention on the Rights of the Child states that every child has the right to grow up in a stable and safe environment where they receive the warmth and support they need for their development (Strijbosch et al., 2015). Children living in socially deprived conditions may face lifetime social, mental and physical issues and consequently be a social burden as well. The aim of youth care is to improve the situation of the children who are affected by this. The Netherlands has a long tradition in child and youth social services with a high standard of professional practice (Ditters, 2019).

Since 2015, with the introduction of the Youth Act, municipalities in the Netherlands are responsible for youth care, including contracting youth care providers. This reform, however, did not yield the intended improvements in quality and efficiency, while costs of youth care do rise sharply (Ditters, 2019). The latter does not apply to all municipalities. This raises the question of whether this has to do with differences in the efficiency of providing youth care, and if so, whether this might have been influenced by the design of the procurement. To answer this question, we conducted an empirical analysis of data on youth care in 352 Dutch municipalities

In this paper, we address two general questions:

1. What is the cost efficiency of providing youth care services?
2. What are the main purchase features that affect cost efficiency of youth care services?

In Section 2, we present a brief description of the institutional setting of Dutch youth care. This is followed by a description of the research method employed in Section 3 and the data used in Section 4. In Section 5, the results of the analyses are presented. Section 6 concludes the paper.

1.1. Institutional setting Dutch youth care

Dutch municipalities are responsible for the whole continuum of care for children, young people and families in need of help. These services include physical and mental health care and cover a wide range of services for children and families, ranging from universal and preventive services to specialised care for children and young people up to the age of 18 years.

A significant portion of the municipal costs for youth care is spent on youth care providers. Although a municipality can choose to perform youth care in-house, most municipalities opt to outsource youth care to care providers. The Youth Act does not impose any obligations regarding the design of the procurement of youth care. Municipalities are free to determine this themselves. In addition to the direct costs for purchasing youth care, municipalities incur administrative and bureaucratic costs for drawing up contracts, monitoring and evaluating programmes and dealing with financial and legal matters.

The most common forms of procurement for youth care are subsidy, government contract and 'Open House' (NJI/PPRC, 2018; Wind and Uenk, 2020). In the case of outsourcing through a subsidy, the municipality provides financial resources for the execution of certain activities without being able to enforce them. Moreover, a municipality can only impose limited requirements on the execution of the activities. However, due to the legal duty to provide youth care, this approach entails significant risks for municipalities to fulfil that obligation.

If a municipality chooses outsourcing through a government contract, the services of the care provider can be enforced. If the care provider fails to fulfil its obligations, the municipality can still enforce compliance through the courts. In this way, the municipality has a formal guarantee that it fulfils its obligation to provide care. Additionally, a government contract provides better opportunities for content and quality management.

In the case of outsourcing through 'Open House', a municipality enters into an agreement with all care providers that meet the municipality's conditions, including the rate of care to be provided. As a result, municipalities have an (enforceable) agreement with multiple providers, but there is only delivery when a citizen contacts a provider. This is because citizens choose their own care provider.

In the case of outsourcing through a government contract, municipalities can choose from various procedures to make agreements with providers (NJI/PPRC, 2018; Wind and Uenk, 2020). The three most commonly used procedures are:

- the classic procurement procedure;
- the Zeeland model;
- the dialogue-oriented procedure.

The classic procurement procedure is legally established. The municipality publishes a contract with the conditions that the contractors must meet and the criteria for awarding the contract based on price and quality and invites providers to submit their tenders. The municipality awards the contract to the provider(s) with the best price/quality ratio.

The other two procedures are not legally established but have been developed in practice within the possibilities of the procurement law. In the Zeeland model, the municipality prepares a programme of requirements and publishes the contract. In order to qualify for the contract, providers only need to demonstrate that they meet the requirements. Ultimately, the client chooses their care provider from all contracted care providers.

The dialogue-based procedure is also known as 'administrative procurement'. This procedure is similar to the Zeeland model, except that the municipality and providers agree in advance on the rules they will follow in reaching an agreement. The municipality then organizes dialogue sessions with the providers to negotiate the conditions for providing youth care. The final outcome is the municipality codifies an implementation agreement with the providers to meet the requirements.

Another aspect of outsourcing concerns the form of the contract, in particular the degree to which a contract provides certainty for the revenue of care providers. The contract can be designed by one of the following four forms:

- framework agreement without intermediate entry;
- framework agreement with intermediate entry;
- fixed budget;
- budget cap.

In the case of a framework agreement without intermediate entry, there is no revenue guarantee but the certainty about the number of providers from which clients can choose. This does not apply to the framework agreement with intermediate entry, where new care providers can be added. This type of contract therefore provides the least certainty for care providers. A fixed annual budget ('lump sum') offers the most financial security for care providers. This budget does not depend on the actual use of the support. If a budget cap is chosen, the care provider has the certainty of being able to use the support up to the budget cap. However, the compensation depends on the actual use of support.

Also important in purchasing care and support are the agreements made with providers on the financial compensation of activities. The three most common funding variants are:

- production-based funding;
- output-based funding;
- task-based funding.

In production-based financing, also known as p x q- or effort-based financing, the municipality pays for the efforts provided (per client) based on a fixed price for an effort irrespective of the outcome. Alternatively, in output-based financing, the provider's compensation is dependent on the achieved results (the output) per client, such as 'establishing a daily structure'. A true performance-based compensation is rare or non-existent. In task-based financing, the focus is also on the result, but not for client-level support, but for area-level support (e.g., all residents of a neighbourhood, district or city). In addition to the three financing forms mentioned, there are various mixed forms.

In addition to contract and financing forms, municipalities can choose to procure youth care for some or all types of care in an integrated manner, that is, together with Social Support Act (SSA) services. Another choice concerns whether or not to collaborate with other municipalities in the procurement of care. Procurement is usually done jointly, in varying sizes of collaborations. Only a

few municipalities procure (parts of) youth care independently (Wind and Uenk, 2020). The final aspect of the procurement concerns the duration of the contract that can vary from just a couple of months to five years.

1.2. Methodology of efficiency measurement

SFA and DEA are two mainstream methods for estimating the efficiency of firms. These methodologies have been used to analyse the relative efficiency of firms, departments, industries or other decision-making units. SFA, developed by Aigner et al. (1977) and Meeusen and Van den Broeck (1977), is a parametric and stochastic method. A standard cost or production function is estimated by maximum likelihood methods where the error component consists of random noise and a one-sided stochastically distributed efficiency component. Detailed discussions and applications of the SFA approach can be found in a number of papers (Blank and Lovell, 2000; Kumbhakar and Lovell, 2000; Coelli et al., 2005; Greene, 2008; Parmeter and Kumbhakar, 2014).

DEA is derived from early work by Debreu (1951) and Farrell (1957) and applied by using linear programming techniques (Charnes et al., 1978; Banker et al., 1984; Färe et al., 1986). The aim of this methodology is to envelop the data points as closely as possible, establishing the best practice frontier by connecting the efficient observations. The (cost) efficiency scores are calculated from the distance to these efficient observations or convex combinations of them.

There has been a tendency in the literature to try to combine the best of both worlds. Kuosmanen (2008) developed a technique that converts a DEA formulation into a stochastic formulation that can be estimated by maximum likelihood techniques. Fan et al. (1996) use standard kernel methods based on maximum likelihood. They apply the stochastic frontier model without the rigidity of a parametric representation of the technology. Johnson and Kuosmanen (2015) in Ray et al. (2015) present a more elaborate discussion of these techniques.

Each methodology has its merits and pitfalls. Criticism of SFA focuses on the required functional specification of the model and the distributional assumptions about the (cost) efficiency component. Criticism of DEA focuses on the lack of a stochastic component and the difficulty of controlling for environmental variables. It is generally recognised that the advantage of SFA is that it takes into account measurement and specification errors, whereas the advantage of DEA is the flexibility of the production technology since no functional specification is required.

In this paper, we apply a method that combines the best of both worlds and is based on the idea of local estimation. It applies weighted least squares where the weights depend on the distance of an observation to all other similar observations. Since the data show a large variation in the values for the relevant variables, the rigidity of the functional form—even for the so-called flexible forms—makes it difficult to obtain accurate estimates. By applying a separate regression analysis for each of the observations, maximum flexibility is achieved without sacrificing the stochastic elements of the analysis. A similar method for deriving cost efficiency scores in the case of a global estimation of a cost function has already been proposed by Blank and Meesters (2012).

We define cost efficiency as the ratio between frontier costs and actual or observed costs. Frontier costs are the minimum attainable costs producing given amounts of distinct outputs and at given input prices. A cost efficiency of 80% implies that given outputs at given input prices can be produced at 80% of observed costs. Mathematically,

$$Cost\ efficiency = \frac{C^{fr}(\boldsymbol{Y})}{C^{obs}(\boldsymbol{Y})}, \tag{1}$$

whereby

$C^{fr}(\boldsymbol{Y}) = frontier\ cost\ to\ produce\ Y$;

$C^{obs}(\boldsymbol{Y}) = actual\ (observed)\ cost\ to\ produce\ Y$.

Since we only research a cross-sectional set of municipalities, there is no need for controlling cost for general input price differentials or for technical change. Since the Netherlands is a small country, there is little spatial variation in labour input prices. Furthermore, wages are also subject to collective labour agreements. So the implicit assumption here is that youth care providers are operating under the same technology constraints and equal input prices. Operating under the same technology constraints must be regarded as an equivalent of equal access (note, access not actual practice) to the same technology. In a small country like the Netherlands, no regional variation in input prices exists. Employees are working under the same collective labour agreements. Further, it is assumed that services provided may vary given differences in youth's case mix or needs (indicated by heterogeneity). Youth care demand may vary regionally. For example, drug or family-related problems may vary according to the degree of urbanisation. We calculate frontier costs based on the results of a regression analysis. The corresponding regression equation can therefore be written as follows:

$$\ln(c_l) = a_0 + \sum\nolimits_m b_m \ln(y_{lm}) + het_l + eff_l + err_l, \tag{2}$$

where

$c_l = actual\ costs\ municipality\ l$;

$y_{lm} = production\ of\ service\ by\ municipality\ l$;

$het_l = percentage\ of\ deviating\ costs\ municipality\ l\ due\ to\ the\ heterogeneity\ of\ production$;

$eff_l = percentage\ of\ additional\ costs\ due\ to\ inefficiency\ municipality\ l$;

$err_l = measurement\ error\ municipality\ l$.

We impose the theoretical constraint of homogeneity of Grade 1 in outputs. This constraint reflects the condition that a 1% increase in all outputs leads to a 1% increase in cost.

Equation (2) is called a double logarithm or a Cobb–Douglas specification (Cobb and Douglas, 1928) and can be seen as a rather simple specification for what could be a complex relationship. A common and appropriate and popular choice for the cost function among many others would be the translog function, which also includes quadratic and cross terms of services and resource prices (e.g., see Christensen et al., 1973). A general criticism is that in spite of the alleged flexibility of the functional forms, it still is not flexible enough to model the complex cost structure. In particular, in the case of a wide range and scope of the services delivered among firms, the cost structure of

small and large firms or firms with a completely different service mix may differ to such an extent that it may be impossible to capture by a smooth function. This applies to the analysis of Dutch municipalities in size and scope. It would therefore make more sense to establish the cost structure locally. Locally here means that only municipalities that produce a similar amount of outputs are included in the regression analysis. The parameters of the cost function that are estimated then depend on the data from firms that are assumed to have a similar cost structure.

This approach can also reduce the heterogeneity of the services provided. Large municipalities may have clients with different problems than small municipalities. Although heterogeneity may be reflected by the various outputs, the remaining heterogeneity may be masked in each of the distinct outputs as well. Since we are not able to directly measure within heterogeneity, we control for it through a number of environmental variables, such as crime rate, education level of the population and percentage of the population on the social minimum.

Efficiency is defined as the difference in costs among municipalities that is related to managerial characteristics of the municipality, in this case, in particular to the characteristic of the purchasing contracts of youth care. This approach has become more common in efficiency research and is based on the so-called scaling property. Instead of deriving cost efficiency measures in the first stage and consecutively regressing these cost efficiency measures on a set of determinants in the second stage, the effects of the determinants are directly derived in only one stage (Wang and Schmidt, 2002; Alvarez et al., 2006; Blank, 2020).

$$obeff_l = \exp\left[-\sum_k \theta_k z_{lk}\right], \tag{3}$$

$$z_{lk} = characteristickofmunicipalityl;$$

a_0, b_m, h, het_d and θ_k are the parameters of the model to be estimated. The parameter a_0 is the constant in the model, the parameters b_m are elasticities and represent the effect of a growth in production on the growth of costs. The parameters het_d shows the percentage effect of the complexity of the services provided on the costs of a municipality. The parameter θ_k represents the share of determinant k in total inefficiency (Alvarez et al., 2006; Parmeter, 2018).

Obviously, since the set of efficiency determinants is limited to the purchasing process, the outcomes will only include a part of the actual inefficiencies. Since the focus of this paper is on the effects of the purchasing process on efficiency, it must be stressed that the estimated efficiencies are underestimating the actual values. The analysis could be extended, for instance, by further disentangling the residuals by techniques such as the so-called thick frontier approach (Bauer et al., 1991; Wagenvoort and Schure, 2006; Blank, 2018) or modified ordinary least squares.

The above model can be estimated with locally weighted least squares. This technique applies a weighted regression analysis for each municipality separately. The weight depends on the distance from the other observations to the observation under consideration. The method gives large weights to observations that are to the observation being analysed and small weights to observations that are further away. The large number of observations even allows us to exclude two third of the observations in each regression analysis.

Since we are only interested in a local estimator of the production technology at a given observation i (= *1, …, I*), it is appropriate to use a first-order Taylor approximation at the given point.

However, there is no objection to using higher order expansions, except for the number of parameters to be estimated. Note that we only use the Taylor approximation for an estimate of the cost and the gradient of the cost at the given point. The weights are derived from a tricube function:

$$weight_i = \left[1 - \left(\frac{d_{il}}{\max d_l}\right)^3\right]^3 \forall i \in \omega(l)\,; otherwise\ weight_i = 0, \tag{4}$$

with

$weight_i = weight observation\ i,$

$d_{il} = distance\ from\ i\ to\ l,$

$max d_l = maximum\ distance\ to\ l\ within\ \omega(l),$

$\omega(l) = set\ of\ nearest\ neighbours\ of\ l,$

where

$$d_{il} = \sum\nolimits_m |y_{im} - y_{lm}|. \tag{5}$$

Some of the assumptions made in the estimation procedure may considered rather arbitrary. We therefore conduct a sensitivity analysis, in particular with respect to the weighting function (Equation 4) and the cut-off point that defines the set of nearest neighbours. We evaluate the outcomes by a visual inspection of the graphs reflecting the estimation results and by conducting some formal tests on the efficiency scores (Cohen's d).

2. Data

We distinguish four groups of variables: input variables, production variables, environmental variables and efficiency determinants. Inputs are measured by the amount of costs. Since we only apply cross-sectional data and assume there is no spatial variance in input prices, there is no need for controlling cost with price indices.

The production is measured by the number of trajectories of different types of care: ambulant care (also including personal budgets), residential care and residential care for youth protection and youth probation.

Crime rate and youth care rate are the indicators used as environmental variables. Crime rate is defined as the number of reported crimes per capita and may be regarded as an indication of the severity of care issues. Youth care rate is defined as the ratio of residents receiving youth care and the number of residents under 19 years of age. This variable may be seen as a selection variable for entering youth care. The larger the value of this variable, the lower the average severity of care issues. It is assumed that access to youth care is based on prioritising the most severe cases, that is, triage.

We also included other environmental variables such as average household income, the share of one-parent-with-children households and the share of families with social benefits. Since all

Table 1
Statistical description of municipality youth care data, 2021 ($n = 352$)

Variable	Mean	St. dev.	Minimum	Maximum
Inputs				
Total cost (x 1000 euro)	15,045	22,730	205	26,800
Production				
Ambulant trajectories	1745	2497	10	27,765
Residential trajectories	149	205	0	2020
Youth care and youth probation	156	255	0	2910
Environment				
Crime rate (crimes per capita)	0.03	0.01	0.01	0.07
Youth care rate (youth with care per capita 0–18 years)	0.15	0.03	0.06	0.27
Purchasing features				
Open House	0.34	0.42	0	1
Dialogue and Zealand	0.44	0.43	0	1
Intermediate access	0.51	0.39	0	1
Budget constraint	0.13	0.29	0	1
Production funding	0.62	0.36	0	1
Integrality Social Support Act	0.27	0.38	0	1
Collaborating municipalities	11.08	4.7	1	21.57
Duration of contract (years)	2.86	1.1	0.93	5

these variables did not show any significant relation with cost, they are further excluded from the discussion. The last group of variables refer to the purchasing features as discussed in Section 2. The statistics of the data are presented in Table 1.

Output and environment data at the municipality level were obtained from Statistics Netherlands. Total costs were derived from the database FINDO, an integral web-based database of the Ministry of the Interior and Kingdom Relations, consisting of data from the financial information system of provinces and municipalities. Although FINDO is notorious for its incompleteness, in this case, we were able to subtract consistent and reliable data for almost all municipalities, probably due to the fact that we only needed cost data on a rather high aggregation level. Data on purchasing characteristics were obtained from the database of the Public Procurement Research Centre (PPRC). These data are presented on the level of municipality times care product. We therefore had to aggregate the data to the municipality level. In only three cases, some data corrections were made due to a merger. Furthermore, we observed that data in the PPRC were not always complete. In that case, we magnified the values to such an extent that the sum of the values was consistent with the given totals. After further inspection of the data for outliers, we were able to compile a complete dataset of 352 municipalities.

3. Results

Since we conduct a separate regression analysis for each of the municipalities, we have a set of 352 estimation results. Given the voluminous amount of numbers, they will be presented in the form of box plot instead of tables. In Fig. 1, we summarise the estimated parameters of the output and environmental variables, followed by Fig. 2 in which the summary of the corresponding t-values

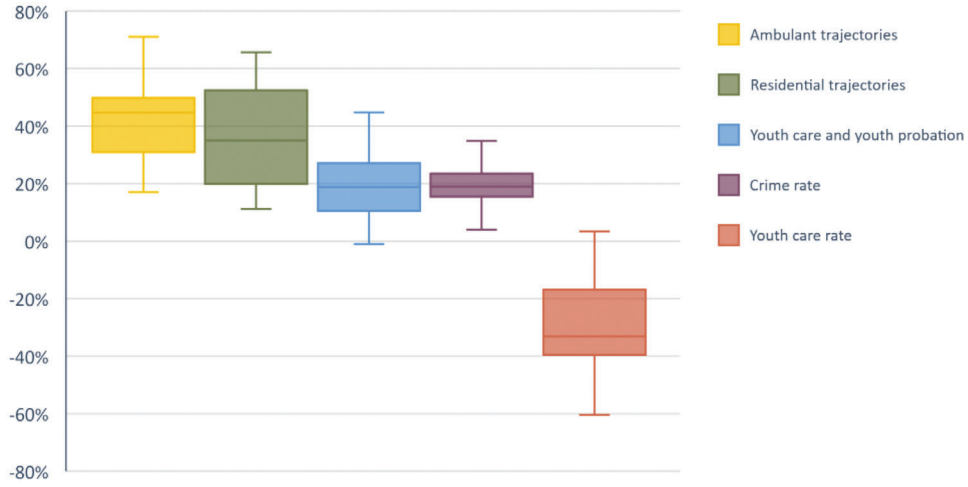

Fig. 1. Parameter estimates effects outputs and environment on cost

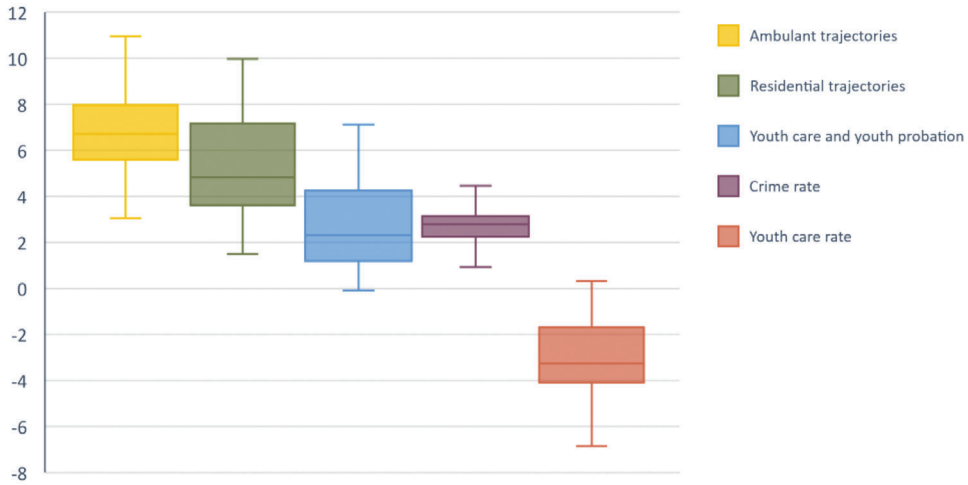

Fig. 2. *t*-values corresponding to estimated effects of production and environment variables on cost.

is presented. Figures 3 and 4 show the estimated parameters of the purchasing features and the corresponding *t*-values, respectively. In Fig. 5, we present the efficiency scores. In this section, we primarily focus on the estimation results and statistical testing. In the concluding section, we will explain the outcomes in an economical sense in more depth.

For the baseline of our analysis, we use the tricube weight function and the nearest 120 municipalities. At the end of this section, we present the outcomes of some alternatives.

The estimated parameters of the three output variables can be interpreted as estimates of the share of each production variable in total cost (due to homogeneity constraint). In Fig. 1, we report that roughly 30% to 50% of the costs are related to ambulant youth care, 20% to 45% to residential youth care and 15% to 30% to youth protection and probation. Incidentally, the reported minima

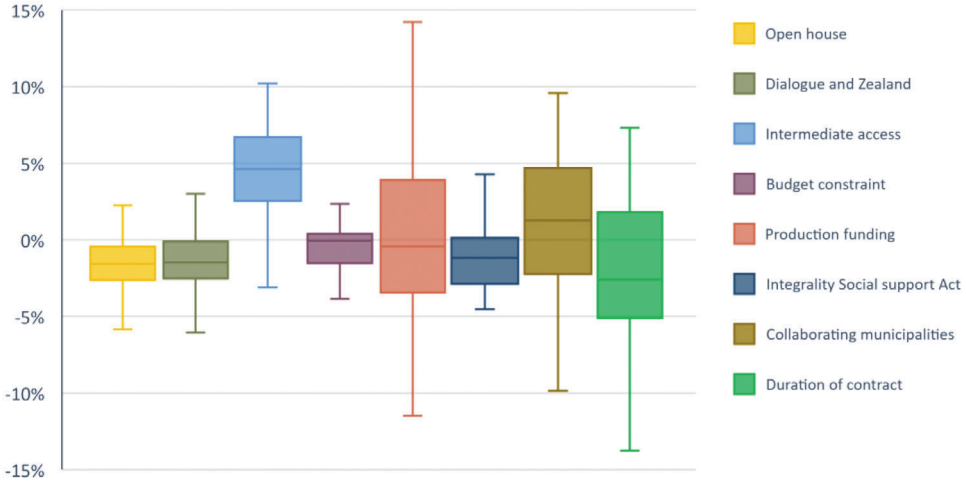

Fig. 3. Parameter estimates of effects of purchasing features on cost.

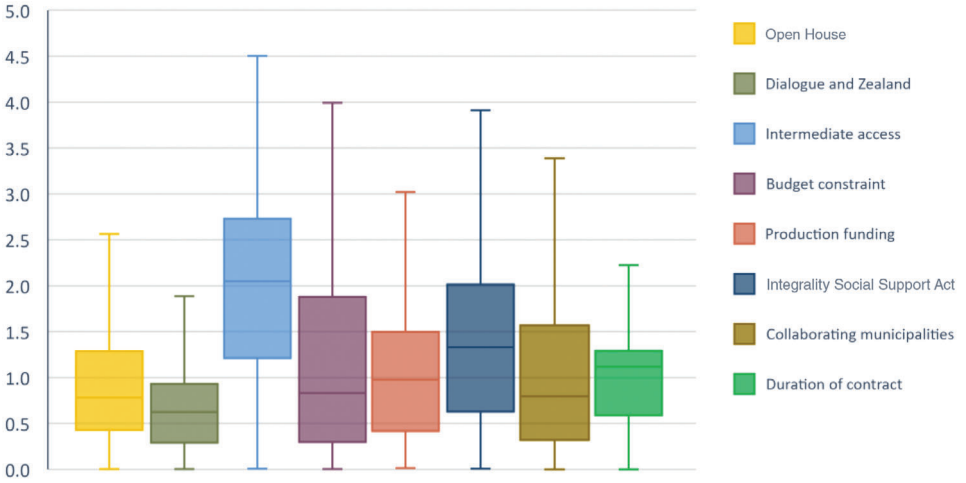

Fig. 4. *t*-values corresponding to estimates of effects of purchasing features on cost.

and maxima show that these shares can differ greatly among municipalities. The estimated 'crime' parameter—relating to the environmental factor number of crimes per capita—appears to have a median greater than 10%. This means that the costs of a municipality with 10% more crimes per capita, compared to another municipality, are 1% higher ($= 0.1\% \times 10\%$). Obviously, the estimated crime parameter indicates that the effect is somewhat higher in municipalities with a high crime rate. The estimated youth care rate parameter implies a negative impact on cost with a median value of -35%. The larger the value of this ratio, the lower the cost, implying that less severe cases contribute to lower cost.

The reliability of the estimates can also be derived from the statistical analysis. Figure 2 gives a statistical description of the *t*-values. It represents the relationship between the estimated parameter

Fig. 5. Efficiency scores.

and its standard error. Usually, a critical value of 1.98 (note $n = 120$) is used as a threshold value. If the t-value is larger than this critical value, then the probability that the parameter value is unequal to zero is greater than 95%.

Figure 2 shows that the t-values for the parameter estimates for the production variables are significant at the 5% level. Only for a limited number of municipalities, the t-values of the youth care and probation variable are lower than the 5% threshold. This also holds for the environmental factor crime rate and the youth care rate.

Figure 3 presents the parameter estimates of the effects of purchasing features on cost.

In Fig. 3, we show that most characteristics have only a limited influence on explaining cost variation. The size of the various effects is in nearly all cases less than 10%. In most cases, the effects have a value close to zero. There are two purchasing characteristics where the 'box' completely is beneath or above the zero line. This means that at least 75% of the estimated parameters are either positive or negative. This holds for

- Open House;
- framework agreement with intermediate access.

The effect of an 'Open House' outsourcing on costs is negative for a large majority of municipalities. This means that the application of 'Open House' contracts has a cost-reducing effect for those municipalities or a positive effect on cost efficiency. However, the effect is small.

We find a clear positive effect on costs and therefore a negative effect on cost efficiency in the possibility of intermediate access within a framework agreement. With this contract form, there is the opportunity for healthcare providers to subscribe for a contract at a later date.

With regard to the other purchasing characteristics, the direction of the effects cannot be determined unequivocally and/or the estimated effects are also limited. This means that from a cost perspective, no unequivocal statements can be made about the influence of the form of outsourcing, the use of budget restrictions (fixed budget or budget cap), the method of funding, whether or not integral tendering of SSA services, the scope of the collaboration and the term of the agreement. In

Table 2
Estimates of log odds model efficiency scores and quality variables

Variable	Estimate	St. dev.	*t*-value
Repeated recourses	−2.561	1.285	−1.99
Completion as planned	−1.069	0.683	−1.56
Constant	2.966	0.515	5.76

the case of production funding, for example, there is a large degree of spread in the results and the direction of the effect (positive or negative) is not even unequivocal.

Figure 4 presents the corresponding *t*-values of the estimated parameters of purchasing features on costs.

The *t*-values displayed in Fig. 4 show that statistical significance is found in a few cases. For intermediate access, less than half of the municipalities shows a statistically significant effect. Even in case we lower the critical value to 1.65 (significant at the 10% level), only a modest number of the estimated parameters meets this threshold. One may argue that we only use 120 neighbour observations in the regression analyses, which may be regarded as a low number considering the 13 parameters to be estimated. This may also partly explain the poor outcomes of statistical significance.

Another source of the modest effects and low statistical significance is the 'age' of a contract. It is too be expected that rather new contracts require some time to be effectively implemented in the business operation. So there may be a difference between the short- and long-term effects of contracts, a distinction that could not be taken into account.

From the parameter estimates and the residuals and applying Equation (3), we derive the efficiency scores related to the purchase features. The results are presented in Fig. 5.

Efficiency scores directly related to decisions in purchasing process vary between 0.643 and 1 with an average of 0.837. Note that since we are depending on the available data, only a limited number of possible features of the purchasing process are included, which implies that these efficiency scores may be overestimated. From the estimation results, we can also derive the standard errors of each of the efficiency scores. They vary between 0.026 and 0.148 with a mean of 0.086 implying a large confidence interval.

3.1. Some additional tests

There are a few caveats to consider regarding the outcomes. The content of contracts can vary among municipalities, as well as the outcomes of care provision. Reliable indicators of outcomes are limited. Nevertheless, we were able to do some checks on quality effects. Since efficiency scores are bounded by zero and 1, we apply a log odds model of efficiency scores on the quality variables 'repeated recourses' and 'completion as planned'. The results are presented in Table 2.

These results demonstrate that there is a statistically significant negative correlation between the log odds of the efficiency scores and repeated recourses. This implies that high values of repeated recourses (low quality) are related to low-efficiency scores. In this case, quality and cost efficiency move together in the same direction. Based on this indicator, the commonly asserted claim that cost

Table 3
Sensitivity tests on parameter estimates and efficiency scores

Variable	Triangular weights	Number of neighbours = 80
Visual inspection estimates	Negligible effects on output and environmental parameters Smaller variance of effects on purchase features	Slight smaller effects for most variables
Visual inspection *t*-values	Little improvements for some of purchasing features	Slight decline for most variables
Mean differences	0.008	0.022
Standard deviation differences	0.014	0.042
Cohen's d	0.510	0.517

efficiency comes at the expense of quality cannot be supported. In fact, the opposite seems to be true. Results also show that efficiency scores show no significant correlation with cost efficiency. Any hypothesis about the correlation between this quality variable and efficiency scores must therefore fail to be accepted.

We also conducted two other tests related to the rather arbitrary choices on the weighting function and the cut-off point for the set of neighbours. The first one concerns the choice for the tricube function for the weighting function. The tricube function is a good candidate since it has a rather flat distribution at the top. This implies that a rather large subset of observations that are close to the firm under investigation receives a higher weight. The weight of observations outside this subset declines fast. The literature on weight functions provides a large number of alternatives (It would be very cumbersome to test the complete set of alternatives. Instead, we choose a weight function that could be regarded as quite the opposite of the tricube function: the triangular function.)

$$weight_i = \left[1 - \left(\frac{d_{il}}{maxd_l}\right)\right] \forall i \in \omega\,(l)\,,\ otherwise\ weight_i = 0. \tag{6}$$

The triangular function is a linear decreasing function of the distance and shows a direct decline of weights starting from the top. This means that the outcomes may be more dominated by the firm under investigation itself and by very close neighbours.

The second choice concerns the number of firms that are included in the set of neighbours. The weights for firms not belonging to the set of neighbours are set to zero. If the number of firms in the set of neighbours is small, the estimated efficiency scores better suit the concept of efficiency. On the other hand, the reduced number of neighbours may reduce the statistical precision of the estimate. We test the influence of the number of neighbours by reducing the number of neighbours from 120 to 80.

From Table 3, we conclude that using triangular weights hardly affects the parameter estimates. Only a few parameters on the purchasing features show a little increase in t-values. In terms of efficiency scores the difference between the outcomes of the two weighting functions is negligible. The standard deviation is 0.014, and Cohen's d equals 0.51 implying that both sets of efficiency scores are much alike.

The downsizing of the number of neighbours also affects the parameter outcomes in a very limited way: the effects in the $N = 80$ variant are a little bit smaller than in $N = 120$ variant. This holds for the t-values as well. The impact on the efficiency scores also is very small, regarding the mean differences in the efficiency scores ($= 0.022$), the standard deviation ($= 0.042$) and the corresponding Cohen's d, also implies that both sets of efficiency scores are much alike

4. Conclusions, recommendations and further research

This paper analyses the efficiency of youth care in the Netherlands, which can be linked to the way municipalities purchase these services. This is a topic that so far has hardly been covered by academic research. The methodology presented here may also be useful for applying in other areas of public services and should therefore become a useful tool in public management. The outcomes of this research are particularly useful for local policymakers in designing efficient purchasing policies in youth care.

Based on data on youth care in 352 Dutch municipalities in 2021, the analysis reveals substantial variations in cost efficiency related to variations in the way services are purchased. Some municipalities can provide the same services at only 65% of the current cost. On average across all municipalities, the cost efficiency is about 84%. This means that an average municipality can deliver the same services at 16% less costs by changing its purchase process.

As noted above, these efficiency differences can only be attributed to differences in the design of purchase policies. Since there may be other factors that affect the efficiency of the service provision, the efficiency scores presented here therefore underestimate the real values. Various characteristics have been examined, such as the type of outsourcing, procurement procedures or funding methods. In total, eight characteristics were tested to determine the optimal procurement policy for a municipality and the consequences of suboptimal procurement policy in terms of cost efficiency. We briefly discuss the outcomes.

Open House refers to the freedom for youth care users to choose the provider of their preference as opposed to the model where municipalities specify the provider. The outcomes show that Open House improves efficiency, probably due to a lower interference of the municipality in the selection process.

The procurement procedure refers to the process of drawing up a contract. In the classical contract, the municipality determines the conditions and requirements of the contract, whereas in the Dialogue and Zealand procedure, the providers have a strong say in the contents of a contract. The results show that for nearly all municipalities the latter is preferable since this procedure increases efficiency. One of the reasons is that by involving the providers in this procedure, the information gap between the contractor and provider can be bridged.

Flexibility in a contract may also play an important role. It shows for instance that the possibility of entering new providers in a framework contract has a negative effect on efficiency. This is a striking result since it is to be expected that the intermediate access would increase competition between providers. However, this flexibility can also be interpreted by incumbents as a higher risk of losing clients, which has to be compensated by higher tariffs.

In order to mitigate any risks associated with supplier-induced demand, contracts also include budget restrictions. It is to be expected that budget constraints may increase efficiency, in particular

in a market with increasing demand. However, it turns out that the estimated effects on efficiency are close to zero. Apparently, the pressure of demand does not seem to be an incentive for enhanced efficiency. This is supported by the phenomenon of increasing waiting queues for clients.

Municipalities apply different funding systems based on different indicators, such as production, outcome and task indicators. The results show that this effect also ranges around zero but with a large variation. This implies that most municipalities do not benefit from one system or the other. Only in a few cases, does there seem to be a substantial effect.

Some Dutch municipalities purchase youth care services in combination with services under the SSA. The estimated effects are close to zero, which implies that economies of scale exist in this case.

However, we found that economies of scale existed with the joint purchase of services by collaborating municipalities. However, for a majority of the municipalities, collaboration seems to decrease efficiency.

Increasing the duration of contracts reduces the long-term risk for service providers, which may be reflected in lower prices. Long-term contracts may also reduce transaction costs by reducing the frequency of contract renewal negotiations. This hypothesis is partly supported by the results of the analysis since in a majority of cases, the estimated effect on efficiency is positive.

There is an important caveat to almost all of the above conclusions. The standard errors are rather large and outcomes are subject to large uncertainties. Nevertheless, by accumulating all the potential efficiency gains by drawing up the right contract and following the optimal purchase process, efficiency gains can be achieved with greater certainty. Municipalities with efficiency scores lower than 80% most certainly can benefit from these insights. Another (downward) bias in the results may come from the fact that just renewed contracts may require some time to get fully implemented. In further research, this type of information should be included in the analysis.

Further, one may argue that a trade-off between efficiency and quality may have affected the efficiency outcomes. However, by testing this hypothesis with two available quality variables, we could not find any support for this. One of the quality indicators even shows a positive correlation between efficiency and quality, implying that the commonly asserted claim that cost efficiency comes at the expense of quality cannot be supported. In fact, the opposite seems to be true. It is recommended that in future, the number of quality variables collected should be increased in the future.

The analyses controlled for several environmental variables. Crime rate affects cost in a negative way implying that high crime rates can be associated with a higher case mix. Furthermore, it was interesting to note the significant negative relation between cost and youth care rate (percentage youth actually in youth care). The youth care rate may be regarded as a proxy for the average case mix. Since it is to be expected that the most severe cases will be provided with care first, this outcome makes sense. Since we originally also included a number of other environmental variables without finding any significant results, it is not to be expected that further explanatory gains will be accomplished by adding more environmental variables to the model.

The general conclusion from this research is that for most municipalities, the efficiency gains are limited and uncertain, with a few exceptions. These few exceptions relate to municipalities that have made a series of 'wrong' decisions regarding the purchasing process. Adding up the various partial efficiency gains from 'right' decisions can have some significant effect on increasing efficiency. It appears that cost largely depends on the actual cost pricing and less on market conditions, information cost and risks. Further, we have to bear in mind that municipalities may have all kinds

of other motives for conditions and requirements in the purchasing process, such as lowering the entry barriers for their clients.

Further research and more concrete data, particularly on case mix and age of contract, are needed to refine the findings that would be useful for effective policy-making.

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References

Aguiar, A.R.P.D., Grassi, I.C.D.F., Gomes, M.I., Ramos, T.R.P., 2024. Home visit scheduling for family interventions: a child protection case study. *International Transactions in Operational Research* 32, 2, 669–691.

Aigner, D., Lovell, C.A.K., Schmidt, P., Schmidt, P., 1977. Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics* 6, 1, 21–37.

Alvarez, A., Amsler, C., Orea, L., Schmidt, P., 2006. Interpreting and testing the scaling property in models where inefficiency depends on firm characteristics. *Journal of Productivity Analysis* 25, 3, 201–212.

Banker, R.D., Charnes, A., Cooper, W.W., 1984. Some models for estimating technical and scale efficiencies in Data Envelopment Analysis. *Management Science* 30, 9, 1078–1092.

Barton, L., Barton, H., 2011. Challenges, issues and change: what's the future for UK policing in the twenty-first century? *Article in International Journal of Public Sector Management* 25, 3, 415–433.

Bauer, P.W., Berger, A.N., Humphrey, D.B., 1991. *Inefficiency and productivity growth in banking: a comparison of stochastic econometric and thick frontier methods*. Working Paper No. 91-17. Federal Reserve Bank of Cleveland.

Blank, J.L.T., 2018. Measuring the performance of local administrative public services. *BRQ Business Research Quarterly* 21, 4, 251–261.

Blank, J.L.T., 2020. The use of the scaling property in a frontier analysis of a system of equations. *Applied Economics* 52, 49, 5364–5374.

Blank, J.L.T., Enserink, B., Van Heezik, A.A.S., 2019. Policy reforms and productivity change in the Dutch drinking water industry: a time series analysis 1980–2015. *Sustainability* 11, 12, 3463.

Blank, J.L.T., Lovell, C., 2000. Performance assessment in the public sector: contributions from efficiency and productivity measurement. In J.L.T. Blank (ed.) *Public Provision and Performance*. Elsevier, Amsterdam, pp. 3–19.

Blank, J.L.T., Meesters, A., 2012. Iteratively weighted least squares on stochastic frontier estimation. Applied to the Dutch hospital industry. In Banker R., Emrouznejad A., Miranda Lopez A.L., de Almeida M.R. (eds) *Data Envelopment Analysis: Theory and applications. Proceedings of the 10th International Conference on DEA*. Natal, Brazil, pp. 167–185.

Blank, J.L.T., Valdmanis, V.G., 2019. *Principles of Productivity Measurement: An Elementary Introduction to Quantative Research on the Productivity, Efficiency, Effectiveness and Quality of the Public Sectoritle* (3rd edn.). IPSE Studies, Delft.

Charnes, A., Cooper, W., Rhodes, E., 1978. Measuring the efficiency of decision making units. *European Journal of Operational Research* 2, 6, 429–444.

Christensen, L.R., Jorgenson, D.W., Lau, L.J., 1973. Transcendental logarithmic production frontiers. *The Review of Economics and Statistics* 55, 1, 28–45.

Cobb, C.W., Douglas, P.H., 1928. A theory of production. *American Economic Review* 18, Supp, 139–165.

Coelli, T.J., Rao, D.S.P., O'Donnell, C.J., Battese, G.E., O'Donnell, C.J., Battese, G.E., 2005. *An Introduction to Efficiency and Productivity Analysis* (2nd edn.). Springer, New York.

de la Higuera-Molina, E.J., Campos-Alba, C.M., López-Pérez, G., Zafra-Gómez, J.L., 2023. Efficiency of water service management alternatives in Spain considering environmental factors. *Utilities Policy* 84, 101644.

Debreu, G., 1951. The coefficient of resource utilization. *Econometrica* 19, 3, 273–292.
Ditters, Y., 2019. *Reform of the Dutch system for child and youth care 4 years later*. Netherlands Youth Institute, Utrecht. https://www.nji.nl/uploads/2021-06/Reform-of-the-Dutch-system-for-child-and-youth-care.pdf
Esteve, M., Garrido-Rodríguez, J. C., Moore, A., Schuster, C., Gómez, J. L. Z., 2024. Assessing the Effects of User Accountability in Contracting Out. *Journal of Public Administration Research and Theory*, 34, 2, 211–223. http://doi.org/10.1093/jopart/muad020
Fan, Y., Li, Q., Weersink, A., 1996. Semiparametric estimation of stochastic production frontier models. *Journal of Business & Economic Statistics* 14, 4, 460–468.
Färe, R., Grosskopf, S., Lovell, C.A.K., 1986. Scale economies and duality. *Journal of Economics-Zeitschrift Fur Nationalokonomie* 46, 2, 175–182.
Farrell, M.J., 1957. The measurement of productive efficiency. *Journal of the Royal Statistical Society. Series A (General)* 120, 3, 253–290.
Fried, H.O., Lovell, C.A.K., Schmidt, S.S., 2008. *The Measurement of Productive Efficiency and Productivity Growth*. Oxford University Press, New York.
Goede, M.D., Enserink, B., Worm, I., Hoek, J.P.V.D., 2016. Drivers for performance improvement originating from the Dutch drinking water benchmark. *Water Policy* 18, 5, 1247–1266.
Greene, W.H., 2008. The econometric approach to efficiency analysis. In Fried, H.O., Knox Lovell, C.A., Schmidt, S.S. (eds) *The Measurement of Productive Efficiency and Productivity Growth*. Oxford University Press, Oxford, UK, pp. 92–250.
Haelermans, C., Blank, J.L.T., 2012. Is a schools performance related to technical change? A study on the relationship between innovations and secondary school productivity. *Computers & Education* 59, 884–892.
Haelermans, C., De Witte, K., Blank, J.L.T., 2012. On the allocation of resources for secondary schools. *Economics of Education Review* 31, 5, 575–586.
Hilhorst, C., Behrens, C., Brouwer, E., Sneller, L., 2022. Efficiency gains in public service delivery through information technology in municipalities. *Government Information Quarterly* 39, 4, 101724.
Hollingsworth, B., 2008. The measurement of efficiency and productivity of health care delivery. *Health Economics* 17, 10, 1107–1128.
Johnson, A., Kuosmanen, T., 2015. An Introduction to CNLS and StoNED methods for efficiency analysis: economic insights and computational aspects. In Ray, S., Kumbhakar, S., Dua, P. (eds) *Benchmarking for Performance Evaluation*. Springer, New Delhi, pp 117–186.
Kumbhakar, C., Lovell, C., 2000. *Stochastic Frontier Analysis*. Cambridge University Press, New York.
Kumbhakar, S.C., Parmeter, C.F., Zelenyuk, V., 2020. Stochastic frontier analysis: foundations and advances I. In Ray, S.C., Chambers, R., Kumbhakar, S. (eds) *Handbook of Production Economics*. Springer Nature, Singapore, pp. 1–40.
Kuosmanen, T., 2008. Representation theorem for convex nonparametric least squares. *Econometrics Journal* 11, 2, 308–325.
Lamothe, M., Lamothe, S., 2009. Beyond the search for competition in social service contracting: Procurement, consolidation, and accountability. *American Review of Public Administration*, 39, 2, 164–188. http://doi.org/10.1177/0275074008316557
Meeusen, W., Van den Broeck, J., 1977. Efficiency estimation from Cobb-Douglas production functions with composed error. *International Economic Review* 8, 435–444.
Niaounakis, T.K., Blank, J.L.T., 2017. Inter-municipal cooperation, economies of scale and cost efficiency: an application of stochastic frontier analysis to Dutch municipal tax departments. *Local Government Studies* 43, 4, 533–554.
Niaounakis, T.K., van Heezik, A.A.S., 2019. *Op Afstand de Beste? Een Analyse van de Productiviteitsontwikkeling Bij IND, CJIB, SVB, RDW en het Kadaster*. IPSE Studies, Delft.
NJI/PPRC., 2018. *Inkoop Jeugdhulp Door Gemeenten: Hoe Zit Het? Facts & Figures*. Nederlands Jeugdinstituut/Public Procurement Research Centre, Utrecht/Lunteren.
Parmeter, C.F., 2018. Estimation of the two-tiered stochastic frontier model with the scaling property. *Journal of Productivity Analysis* 49, 37–47.
Parmeter, C., Kumbhakar, S., 2014. *Efficiency Analysis: A Primer on Recent Advances*. Now, Boston, MA. https://pages.stern.nyu.edu/~wgreene/FrontierModeling/SurveyPapers/Parmeter-Kumbhakar-SFA.pdf

Pérez-López, G., Prior, D., Zafra-Gómez, J.L., Plata-Díaz, A.M., 2016. Cost efficiency in municipal solid waste service delivery. Alternative management forms in relation to local population size. *European Journal of Operational Research* 255, 583–592.

Ray, S.C., Kumbhakar, S.C., Dua, P., 2015. *Benchmarking for Performance Evaluation: A Production Frontier Approach*. Springer, New Delhi.

Strijbosch, E.L.L., Huijs, J.A.M., Stams, G.J.J.M., Wissink, I.B., van der Helm, G.H.P., de Swart, J.J.W., van der Veen, Z., 2015. The outcome of institutional youth care compared to non-institutional youth care for children of primary school age and early adolescence: a multi-level meta-analysis. *Children and Youth Services Review* 58, 208–218.

Wagenvoort, R.J.L.M., Schure, P.H., 2006. A recursive thick frontier approach to estimating production efficiency*. *Oxford Bulletin of Economics and Statistics* 68, 2, 183–201.

Wang, H.J., Schmidt, P., 2002. One-step and two-step estimation of the effects of exogenous variables on technical efficiency levels. *Journal of Productivity Analysis* 18, 2, 129–144.

Wind, M., Uenk, N., 2020. *Monitor Gemeentelijke zorginkoop 2020. Stand van zaken inkoop diensten in het kader van Wmo 2015 en Jeugdwet*. Public Procurement Research Centre, Lunteren.

Zafra-Gómez, J.L., López-Pérez, G., Garrido-Montañés, M., Zafra-Gómez, E., 2023. Cost efficiency in municipal solid waste (MSW): different alternatives in service delivery for small and medium sized Spanish local governments. *Sustainability (Switzerland)* 15, 7.