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, in particular with respect to purchasing policies. Locally Least Squares (LLS) is applied to data of 352 Dutch municipalities operating in 2021. The outcomes reveal significant variations in the cost efficiency of youth care among municipalities. For all municipalities, the average cost efficiency is 70 percent. These efficiency differences can only be partially attributed to differences in the design of purchase policies. It appears that open house outsourcing has a positive effect on efficiency and the so-called intermediate access within a framework agreement has a negative effect on efficiency. Other features such as duration of the contract and collaboration with other municipalities appear to have a minimal effect. Furthermore, there appears to be some modest scale advantages: larger municipalities procure services at lower costs.

Key words: municipality, productivity, ‘cost efficiency’, ‘efficiency determinants’, ‘cost function’, ‘scaling property’, ‘youth care’.

1. Introduction

The public sector contributes to social welfare. Education, law enforcement and health care are important sectors for a well-functioning economy and contribute to a social 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 & Lovell, 2000; Blank & Valdmanis, 2019). One way of introducing more economic discipline into these social programs include privatization 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 organizations (or sectors) that are responsible for the provision of public services to citizens, such as education (Haelermans & Blank, 2012; Haelermans et al., 2012), health care (Hollingsworth, 2008), drinking water supply (Blank et al., 2019; Goede et al., 2016), policing (Barton & Barton, 2011) and the immigration and naturalization services (Niaounakis & van Heezik, 2019). In productivity research there obviously are popular sectors, such as hospitals, nursing homes or universities.

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

Most of these studies focuses 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, and which can be affected by management on short term. Examples are HRM, IT-management (Hilhorst et al., 2022), and collaborations (Niaounakis & Blank, 2017). Another theme that fits in this list regards the way in which the government purchases services in the private sector. How efficient this purchasing is has been investigated for many different services, such as waste collection (Felsö et al., 2012) and road construction and maintenance (Lopez et al., 2009; Niaounakis & Van Heezik, 2017).

However, little research has yet been conducted into some important services. 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. The International Convention on the Rights of the Child states that every child have 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 social 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, in which various reforms have taken place (Ditters, 2019). However, it appears that this does not lead to the desired improvements, while costs do rise sharply. 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. 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?

Before answering these questions, in section two we discuss some theoretical considerations about the principal-agent relationship, followed by a brief description of the institutional setting of Dutch youth care in section 3. In section 4, we will describe the research method employed and in section 5 the data used. In section 6, the results of the analyses are presented. We present conclusions and recommendations in section 7.

2. Principal-agent theory

Management of (local) government has to deal with the decision whether or not to provide services themselves. In case they decide to purchase the services in the private sector they have to face several principal-agent relationship's issues. This applies to all kinds of services and therefore also to youth care. In this section we address some relevant topics of the economic theory about principals and agents to gain a better understanding of the relationship between a municipality and youth care providers. Although in practice sometimes the approach is different, insights from this theory are usually taken into account to a greater or lesser extent in order to mitigate the market failure often present in providing social services.

The principal-agent relationship is a formal relationship in which the principal legally appoints the agent to act on its behalf (Braun & Guston, 2003; Chen, 2022). This relationship is binding under the construction of the law which specifies the responsibility of each party. The principal typically relies on the expertise of the agent in carrying out the formal tasks in the contract and the principal is responsible to remuneration. As part of the contract, the agent is obliged to carry out the assigned tasks with the principal's objective(s) as a priority. Economists have expanded this relationship as one that has significant economic magnitude, which includes the concept of uncertainty and risk (Arrow, 1984). Implicit in this relationship is asymmetric information – where in one party by virtue of expertise and knowledge, is in a better position to know the best way of achieving the principal's objective. Note that this asymmetric relationship fits with the arrangements between the municipalities and youth care providers.

Efficiency incentives: rewards and flexibility

One issue is how the principal can monitor the agent's activities to effectively carry out the task (Sappington, 1991). The key is whether the agent accepts the contractual agreement. If the agent accepts the contract, it determines how much effort is required to meet the objectives of the principal and payment from the principal to the agent is made based on the promises made by the agent. It is therefore, up to the agent to meet all contractual outputs in the most efficient manner. In turn the principal can align the agent's motivation by agreeing that the agent may retain all residuals defined as the difference between expected value and the agent's performance. With this type of agreement, the agent's and principal's motivations are equal. However, the agent accepts the risk and as such need to consider their ability in meeting the prespecified outcome. This theoretical construct closely resembles the Dutch funding formats described in the following section.

An issue arises when the agent's performance is superior to what the principal's expectation but with no added reward. Therefore, without any added compensation beyond the contract, the agent does not have the incentive to provide superior service beyond the principal's expectation. Hence, the

specification of necessary and required outcomes need to be made in the contractual stage of the agreement. This complete agreement as described by the types of contract agreements including the frameworks with or without intermediate entry, fixed budgets, or a budget ceiling. If changes are made regarding the terms of the original contract from either side, the terms and financing agreements may also be altered to reflect changes.

Monitoring

The details of the principal-agent agreement must consider the agent's precontractual information, the environmental factors which can be forecasted (such as the beneficiaries existing conditions) and the ability of the agent to convey to the principal the exact nature of how effective treatment is in meeting objectives and legal obligations. Inaccurate information from either the principal or agent side increases risks of programmatic shortcomings or at worst failure. One way to avoid shortcomings in information is to include input from additional agents which the principal cannot always observe (Sappington, 1991). Hence, relative performance may be used to monitor the best method for achieving the ultimate goal(s) of the principal. Monitoring will be most effective by combining an individual agent's performance with that of relative performance (Sappington, 1991). One very important issue is what Arrow (1984) echoes this sentiment by monitoring outcomes of the activities, since the principal cannot always observe actions themselves

Moral hazard and adverse selection

However, market failures may persist due to *moral hazard* and *adverse selection*. *Moral hazard* arises, for example, if the contractor treats clients who no longer need it, but for which they still receive compensation. Arrow (1984) speaks of hidden action in this case, because the agent has more medical knowledge and the principal relies on it. Principals could use more counter-expertise which can happen with more agencies willing to participate in providing youth care.

Adverse selection arises in the case wherein the agent may try to avoid costly clients who may require more services than the principal would pay the agencies. It is also possible that the agent does not provide the treatment that is necessary (Arrow, 1984).

Auction

One possibility to overcome the above problems is to organize an auction / bid. By allowing the various potential agents to enter the auction, they are disciplined in an implicit way. It is assumed that they have a comparable information position, which means that they are unable to exploit an information advantage over the principal. In the case of an auction, that would mean that they would not win the bid. An auction thus leads to an effective outcome. The winner of an auction offers the services requested by the principle at the lowest possible cost. Risks and uncertainties are also weighed against costs. Execution of the contract may be accompanied by a form of impact monitoring, which not only looks at a full execution of the contract but also at external circumstances that can lead to unexpectedly high costs for the agent.

A long-term relationship between principal and agent can also provide information for the principal in the long term to adjust conditions and services. For this, it is necessary that contracts are sufficiently flexible to make these adjustments. Consider, for example, changes that make innovations in services possible that the principal could not have foreseen in advance.

Political consequences of principal-agent relationships

In political science researchers also study the principal-agent concept. This is how Weber (1958) describes the situation in which agents have influence on the principal who has an information backlog. In particular, the question is whether the principal can persuade the agent to take those

actions that the principal would take if the principal had the same information as the agent (Miller, 2005, p. 204). If the results are insufficient, the political principal will experience negative consequences in terms of losing elections and/or influence in the policy process.

Another problem is how well clients can identify the contractors, for example in terms of what Gailmard (2010) calls the motivation of the public service. Gailmard uses the example of the United States Environmental Protection Agency, where the most important contracts are concluded with contractors who have a pro-environmental vision. Moe (1984) agrees by stating that knowledge of the contractor's preferences can minimize the phenomenon of adverse selection. To this end, the client must investigate the reputation, expertise and honesty of the contractors.

Chen (2022) identifies a potential shortcoming if agents neglect their obligations and intentionally or negligently complete the task inappropriately. This outcome can be particularly difficult if the agent does not behave adequately (Eisenhardt, 1989). Conversely, Hamman et al. (2010) argue that the principal who relies on an agent "turns a blind eye" to actions used by the agent chooses not to remain informed. This is especially problematic when the agent is more self-serving and less pro-social than the principal who goes against the Gailmard (2010) model of motivation for public service.

Therefore, there must be strong surveillance equipment that corresponds to the client's objective with the results produced by the agents. Agents can also incentivize their employees to achieve the organization's and principal's goals through typical inducements, including raises and promotions (Sappington, 1991).

In summary, five conditions can be derived from the principal-agent theory that are important in the design of that relationship:

1. Recognition of the client's ultimate goal – the municipality acting in the best interest and improvement of youths in need.
2. Matching the skills of the agent through knowledge and expertise in meeting the outcome specified in the contract .
3. Identifying possible shortcomings implicit in moral hazard and asymmetric information.
4. Recognize possible best practices in contracting with different agents.
5. Include flexibility in the contract including the possible variables that may deviate from expectations.

It is expected that these five conditions will also play an important role in the design of the procurement of youth care in the Netherlands. In the next section we examine to what extent this is the case.

3. Institutional setting Dutch youth Care

A significant portion of the municipal costs for youth care relates to expenses for youth care providers. Although a municipality can choose to perform youth care in-house, most municipalities choose to outsource youth care to care providers. The Youth Act does not impose any obligations with regard to the design of the procurement of youth care. Municipalities are free to determine this themselves.

The most common forms of procurement for youth care are subsidy, government contract, and "Open House" (NJI/PPRC, 2018; Wind & Uenk, 2020). With outsourcing through subsidy, the municipality provides financial resources for the execution of certain activities without them being

enforceable. 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.

With 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.

With outsourcing through a government contract, municipalities can choose from various procedures to make agreements with providers (NJI/PPRC, 2018; Wind & 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 publicly announces 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 bids. 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 program 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, the difference is the municipality and providers agree in advance on the rules they will follow in arriving to 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 contract form, particularly the degree to which a contract provides certainty for the revenue of care providers. The contract can be designed by one of these four forms:

• framework agreement without intermediate entry;

• framework agreement with intermediate entry;

• fixed budget;

• budget ceiling.

With a framework agreement without intermediate entry, there is no revenue guarantee but the certainty about the number of options from which clients can choose. This does not apply to the framework agreement with intermediate entry, where new care providers can be added. This agreement therefore provides the least certainty for care providers. A fixed annual budget ('lump sum') offers the most certainty for care providers in money terms. This budget does not depend on the actual use of support. If a budget ceiling is chosen, the care provider has the assurance that he can use support up to the budget ceiling. 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 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 (for example, all residents of a neighbourhood, district, or city). In addition to the three financing forms mentioned, there are various mixed forms.

In addition to the procurement, 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 & Uenk, 2020).

In Section 5 (Data) we provide a further explanation of the link between principal-agency issues and the institutional settings.

4. Methodology of Efficiency Measurement

Stochastic frontier analysis (SFA) and data envelopment analysis (DEA) are two mainstream methods to estimate efficiency scores of firms. These methodologies have been used in analysing the relative efficiency of firms, departments, industries or other decision making units. SFA, developed by Aigner et al. (1977) and Meeusen & 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. Extensive discussion and application of the SFA approach can be found in a number of works (Blank & Lovell, 2000; Coelli et al., 2005; Greene, 2008; Kumbhakar & Lovell, 2000; Parmeter & Kumbhakar, 2014).

DEA is derived from early production work by (Debreu, 1951) and (Farrell, 1957) and applied by using linear programming techniques (Banker et al., 1984; Charnes et al., 1978; Färe et al., 1986). The aim of this methodology is to envelop the data points as closely as possible, and 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.

Each methodology has it merits and pitfalls. The criticism of SFA focuses on the required functional specification of the model and the distributional assumptions about the (cost) efficiency component. The criticism on DEA focus on the absence of a stochastic component and the difficulty of controlling for environmental variables. It is generally recognised that the benefit of SFA is that it takes measurement and specification errors into account, whereas the benefit of DEA is the flexibility of the production technology, since no functional specification is required. DEA is an observation by an observation technique that provides a local estimator.

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 & Kuosmanen (2015) in Ray et al.(2015) present a more a elaborated discussion of these techniques.

In this paper, we also 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 weights depend on the distance of an observation to all other similar observations and on the distance to the cost frontier. 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 ones – hinders the establishment of 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 was proposed earlier by Blank & 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 percent implies that given outputs at given input prices can be produced at 80 percent of observed costs. Mathematically:

$$Cost\ efficiency = \frac{C^{fr}(\boldsymbol{Y})}{C^{obs}(\boldsymbol{Y})} \qquad (2)$$

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. 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 exist. Employees are working under the same collective labour agreements. Further it is assumed that services provided may vary given differences in youth' case mix or needs (indicated by heterogeneity). Youth care demand may differ regionally. For example, drug related issues or family related issues may differ by the extent of urbanization. We calculate frontier costs based on the results of a regression analysis. The corresponding regression equation therefore can be written as:

$$\ln(c_l) = a_0 + \sum_m b_m \ln(y_{lm}) + het_l + obeff_l + unobeff_l + err_l \quad (3)$$

Where:

c_l = actual costs municipality *l* ;

y_{lm} = production of service *m* by municipality *l*;

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

$obeff_l$ = percentage of additional costs due to observed inefficiency municipality *l* ;

$unobeff_l$ = percentage of additional costs due to unobserved 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 one percent increase in all outputs leads to a one percent increase in cost.

Equation (3) is called a double logarithm or a Cobb-Douglas specification (Cobb & Douglas, 1928) and may be regarded 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 (see e.g. Christensen et al., 1973). A general criticism is that in spite of the alleged flexibility of the functional specifications, it still is not flexible enough to model the complex cost structure. Particularly, 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 complete different service mix may differ to such an extent that it may be impossible to capture by a smooth function. This particularly applies to the analysis of Dutch municipalities that vary 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 taken into account in the regression analysis. The parameters of the cost function that are estimated then depend on the data of firms that are assumed to have a similar cost structure.

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

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

$$obeff_l = \exp\left[-\sum_k \theta_k z_l\right] \quad (4)$$

z_{dtk} = characteristic *k* of department *d* at time *t*;

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 proportion of determinant *k* in total inefficiency (Alvarez et al., 2006; Author, year; Parmeter, 2018).

What remains from equation (3) is the expression of unobserved variables $unobeff + err_l$. We proceed by combining $eff_l + err_l$ into one single term v_l and treat this term as the classic normally distributed error term in a regression analysis. After estimation we disentangle this term again by following a so-called think frontier approach (Bauer et al., 1991; Blank, 2018; Wagenvoort & Schure, 2006). After conducting the regression analysis we calculate $\exp(-\hat{v}_l)$ representing the percentage increase of cost due to the unobserved variables. In order to get an efficiency score between zero and one, we standardize this score by dividing it by its 90th percentile. We use the 90th percentile instead of the maximum to avoid substantial influence of strong outliers. Resulting efficiency scores greater than one are truncated at one. Mathematically:

$$unobseff_l = \frac{\exp(-\hat{v}_l)}{p90[\exp(-\hat{v})]} \; if \; expression \leq 1, otherwise \; eff_l = 1 \qquad (5)$$

Where:

$\hat{v}_l$ = observed residual from regression analysis for municipality l ;

$p90$ $= 90^{\text{th}}$ percentile.

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 investigation. The method puts large weights on observations that are in close proximity to the analysed observation and small weights to observations that are farther away. The large number of observations even allows us to exclude 2/3 of the observations at 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 that particular point. The weights are derived from a tricube function:

$$weight_i = \left[1 - \left(\frac{d_{il}}{maxd_l}\right)^3\right]^3 \; \forall i \in \omega(l), otherwise \; weight_i = 0 \qquad (6)$$

With:

$weight_i$ = weight observation i

d_{il} = distance from *I* to *l*

$maxd_{il}$ = maximum distance to *l within*

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

Where:

$$d_{il} = \sum_m |y_{im} - y_{lm}| \qquad (7)$$

5. 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 prioritizing 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 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.

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

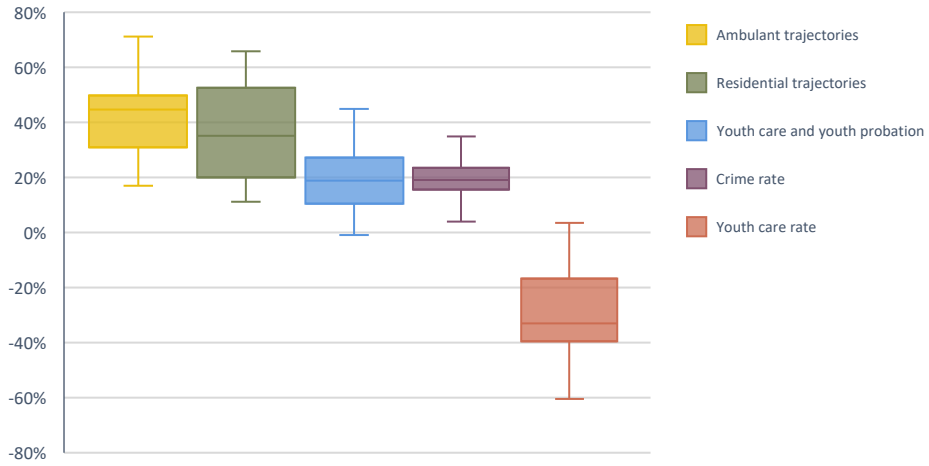
Variable	Mean	St. Dev.	Minimum	Maximum
Inputs				
Total cost (x 1,000 euro)	15,045	22,730	205	26,800
Production				
Ambulant trajectories	1,745	2,497	10	27,765
Residential trajectories	149	205	0	2020
Youth care and youth probation	156	255	0	2910
Environment				
Crime rate (crimes per capita)	0.03	0.01	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 institutional settings and environmental factors express the five aforementioned conditions that can be determined on the basis of principal-agent theory. For example, the ambulant trajectories, residential trajectories and youth care and youth probation reflect the objectives of the principal (the municipalities) that the agents (the contracted care providers) are to meet. Interestingly, the crime rate can be viewed as a factor that the agents must contend with given their location and potential clients which in turn may reflect the principal-agency concerns on moral hazard, asymmetric information, and cream skimming. The purchasing features reflect what in the principal-agent theory is referred to as the specifications of the contract. The access and Dialogue and Zeeland funding arrangements demonstrate the responsiveness of the agent whereas the budget constraint and production funding is linked directly to the fiduciary agreement between the principal and the agents. Integrality with the Social Support Act is relevant as an attempt to lower transaction costs by integrating the execution of two different Acts. Interestingly, the collaborating municipalities permits use of a learning curve as to how best to meet the needs for the youth in need which may be used to mitigate the risk aversion and moral hazard. Finally, the duration of the contract ties directly to the importance of continuity of services that has been pointed out as well as flexibility of time contracts permits the principal to negate any agreements if the agents do not meet the municipalities' objectives.

6. 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 Figure 1 we summarise the estimated parameters of the output and environmental variables, followed by figure 2 in which the summary of the corresponding t-values are presented. In Figure 3 the estimated parameters of the purchasing features and in figure 4 their corresponding t-values are presented. In Figure 5 and 6 we present the purchases related efficiency scores and the unobserved efficiency scores.

Figure 1 Parameter estimates effects outputs and environment on cost



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 Figure 1 we report that roughly 30 to 50 percent of the costs are related to ambulant youth care, 20 to 45 percent to residential youth care and 15 to 30 percent to youth protection and probation. Incidentally, the reported minima 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 percent. This means that the costs of a municipality with 10 percent more crimes per capita compared to another municipality are 1 percent higher (= 0.1 × 10 percent). Obviously, the estimated crime parameter indicates that the effect is somewhat higher in municipalities with a high crime rate. The youth care rate parameter describes the impact that in nearly 100% of cases a significant negative effect on cost with a median value of -35 percent ceteris paribus. The larger the value of this ratio the lower the cost, implying that less difficult cases are given access to youth care.

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 and its standard error. Usually a critical value of 1.98 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 percent.

Figure 2 T-values corresponding to estimated effects of production and environment variables on cost

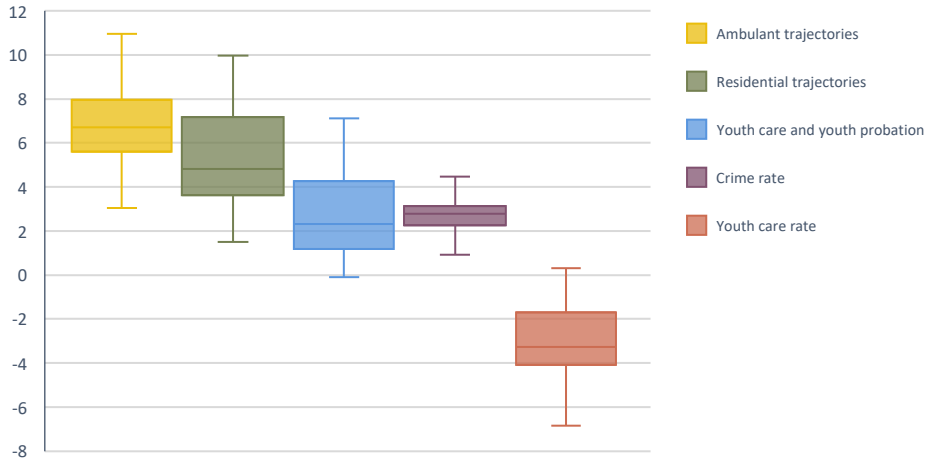
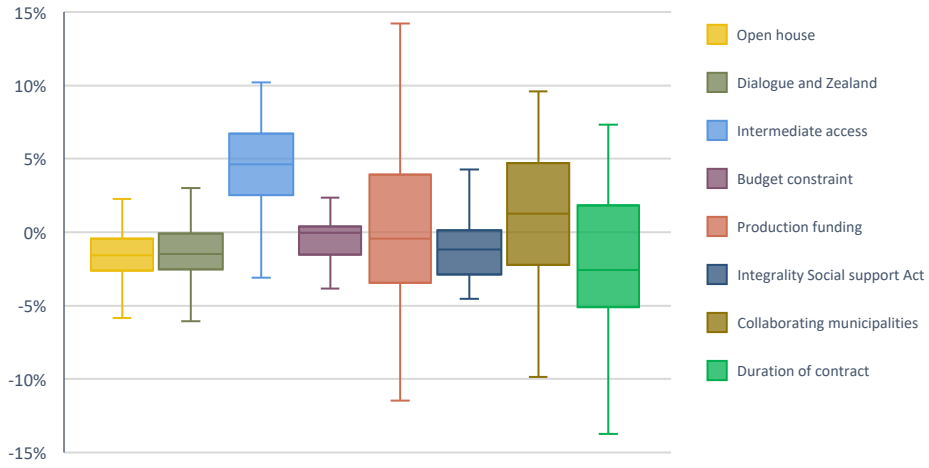


Figure 2 shows that the t-values for the parameter estimates for the production variables are significant at the 5% level. Only for a limited number of municipalities the t-values of the youth care and probation variable are lower than the five percent threshold. This also holds for the environmental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

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

Figure 3 Parameter estimates of effects of purchasing features on cost



In Figure 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 percent. In most cases, the effects have a value close to zero. There are two purchasing characteristics where the 'box' is on one side of the zero line. This means that at least 75 percent of the estimated parameters are either positive or negative. This holds for

- Open house;
- Framework agreement with intermediate access.

With an 'open house', the municipality concludes a contract with every provider that meets a number of conditions. 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-

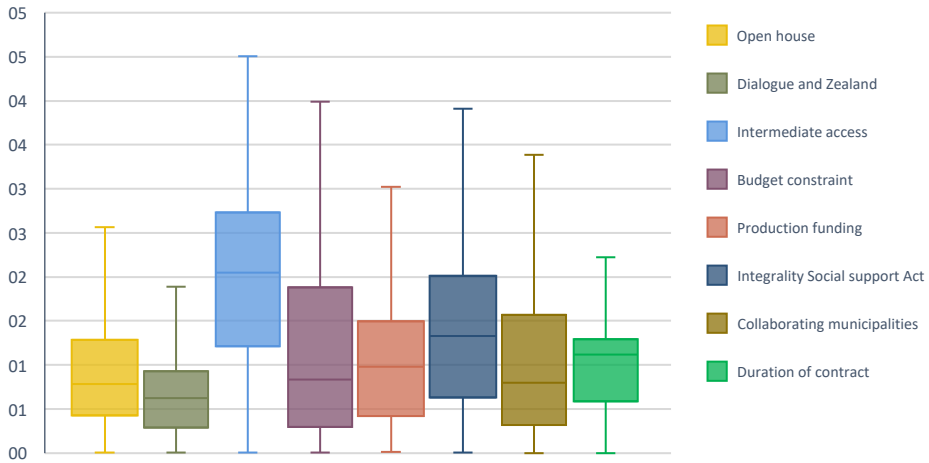
reducing effect for those municipalities, or a positive effect on cost efficiency. However, the effect is small.

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. Higher transaction costs compared to a framework agreement without intermediate access may be to blame for this.

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 ceiling), the method of funding, whether or not integral tendering of Social Support Act services, the scope of the collaboration and the term of the agreement. In 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.

Figure 4 T-values corresponding to estimates of effects of purchasing features on cost



The T-values displayed in Figure 4 shows 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 thirteen parameters to be estimated. This may also partly explain the poor outcomes of statistical significance.

From the parameter estimates and the residuals and applying equation (4) and (5) we derive the purchase features related and unobserved efficiency scores. The results are presented in figure 5 and 6.

Figure 5 Purchase features related efficiency scores

Efficiency scores directly related to decisions in purchase process vary between 65 and 100 percent with an average of 80 percent. Note that we have not included all possible features of the purchasing process, which implies that these efficiency scores may be overestimated.

Figure 6 Unobserved Efficiency Scores

Findings presented in Figure 6 show that next to the purchase features related efficiencies there is a remaining (unobserved) efficiency varying from 55 to 100 percent. Obviously, many municipalities must be able to realize a substantial cost saving. Further investigation by intensive introspection between peer municipalities may reveal some of the backgrounds of these inefficiencies.

There are a few caveats to consider regarding the outcomes. The content of contracts can vary greatly between 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. The quality indicator "completion as planned" shows no correlation with cost efficiency. In contrast, this correlation does exist for the quality indicator "repeated recourse." In this case quality and cost efficiency go hand in hand. Based on this indicator, the commonly asserted claim that cost efficiency comes at the expense of quality cannot be supported. In fact, the opposite seems to be true.

7. Conclusions and Recommendations

The empirical analysis of data on youth care and environmental factors in 352 Dutch municipalities in 2021 reveals significant variations in the cost efficiency of youth care provision among municipalities. For instance, some municipalities can provide the same services at only half the current cost. On average across all municipalities, the (total) cost efficiency is about 70 percent. This means that an average municipality can deliver the same services at 30 percent lower costs. While this figure is subject to some uncertainties, it appears that many municipalities have the potential for cost savings.

These efficiency differences can only be partially attributed to differences in the design of purchase policies. 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.

The most striking result is the negative effect of a framework agreement with intermediate access (compared to without) on cost efficiency. Furthermore, the so-called open house procedure has a positive effect on cost efficiency. This procedure involves a municipality having contracts with multiple providers, and citizens can choose their own provider. The analyses also show that the other procurement characteristics do not have consistent effects.

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 an 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.

In the analyses we controlled for various environmental variables. Crime rate affects cost in a negative way implying that high crime rates can be associated with higher case mix. Furthermore, it was interesting to see the significant negative relation between cost and youth care rate (percentage youth actually receiving 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 noted that efficiency differences can be large and for which we were not able to find any clear explanation it may be advisable for municipalities to implement a form of peer consultation. The results of this study could help municipalities seek insights from comparable municipalities (peers) which is recommended by the tenets of the principal-agent theory.

Literature

Aigner, D., Lovell, C. A. K., Schmidt, P., C.A., K. L., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, *6*(1), 21–37. http://doi.org/10.1016/0304-4076(77)90052-5

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.

Arrow, K. (1984). *The economics of agency. A report of the Center for Research of Organizational Efficiency, Stanford University. Technical Report no. 451.* Stanford: Stanford University.

Banker, R. D., A. Charnes, & 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. http://doi.org/10.1108/09513551111109044

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*. Federal Reserve Bank of Cleveland. Retrieved from http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=econ&AN=0698930

Blank, J. L. T. (2018). Measuring the performance of local administrative public services. *BRQ Business Research Quarterly*, *(on line)*. http://doi.org/10.1016/J.BRQ.2018.09.001

Blank, J. L. T. (2020). The use of the scaling property in a frontier analysis of a system of equations. *Applied Economics*, *00*(00), 1–11. http://doi.org/10.1080/00036846.2020.1763246

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. http://doi.org/10.3390/su11123463

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*. Amsterdam: Elsevier.

Blank, J. L. T., & Meesters, A. (2012). Iteratively Weighted Least Squares on Stochastic Frontier Estimation. Applied to the Dutch Hospital Industry. In R. Banker, A. Emrouznejad, A. L. Miranda Lopez, & M. R. de Almeida (Eds.), *Data Envelopment Analysis: Theory and applications. Proceedings of the 10th International Conference on DEA* (pp. 167–185). Natal, Brazil.

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 ed.). Delft: IPSE Studies.

Braun, D., & Guston, D. H. (2003). Principal–agent theory and research policy: an introduction. *Science and Public Policy*, *30*(5), 302–308.

Charnes, A., Cooper, W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, *2*(6), 429–444. http://doi.org/10.1016/0377-2217(78)90138-8

Chen, J. (2022). Principal-agent relationship: What it is, how it works. Retrieved February 15, 2022, from investopedia.com

Christensen, L. R., Jorgenson, D. W., & Lau, L. J. (1973). Transcendental Logarithmic Production Frontiers. *The Review of Economics and Statistics*, *55*(1), 28–45. Retrieved from http://www.jstor.org/stable/1927992

Cobb, C. W., & Douglas, P. H. (1928). A theory of production. *American Economic Review*, *18 (Supple*, 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 ed.). New York: Springer.

Debreu, G. (1951). The Coefficient of Resource Utilization. *Econometrica*, *19*(3), 273–292. Retrieved from http://www.jstor.org/stable/1906814

Ditters, Y. (2019). *Reform of the Dutch system for child and youth care 4 years later*. Utrecht: Netherlands Youth Institute.

Eisenhardt, K. M. (1989). Agency theory: An assessment and Review. *The Academy of Management Review*, *14*(1), 57–74.

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. http://doi.org/10.1007/bf01229228

Farrell, M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society. Series A (General)*, *120*(3), 253–290. Retrieved from http://www.jstor.org/stable/2343100

Felsö, F. A., De Groot, H., & Van Heezik, A. A. S. (2012). *Cost Efficiency of Dutch Municipal Waste Management Using Stochastic Frontier Aanalysis*.

Fried, H. O., Lovell, C. A. K., & Schmidt, S. S. (2008). *The measurement of productive efficiency and productivity growth*. New York: Oxford University Press.

Gailmard, S. (2010). Politics, principal-agent problems, and public service motivation. *International Public Management Journal*, *13*(1), 35–45.

Goede, M. de, Enserink, B., Worm, I., & Hoek, J. P. van der. (2016). Drivers for performance improvement originating from the Dutch drinking water benchmark. *Water Policy*, *18*(5), 1247–1266. http://doi.org/10.2166/wp.2016.125

Greene, W. H. (2008). The econometric approach to efficiency analysis. In H. O. Fried, C. A. Knox Lovell, & S. S. Schmidt (Eds.), *The measurement of productive efficiency and productivity growth* (pp. 92–250). Oxford University Press Oxford, UK.

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. Retrieved from http://www.sciencedirect.com/science/article/pii/S036013151200084X

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. http://doi.org/10.1016/j.econedurev.2012.02.007

Hamman, J. R., Loewenstein, G., & Weber, R. A. (2010). Self-interest through delegation: An additional rationale for the principal-agent relationship. *American Economic Review*, *100*(4), 1826–1846.

Hilhorst, C., Behrens, C., Brouwer, E., & Sneller, L. (2022). Efficiency gains in public service delivery through information technology in municipalities. *Government Information Quarterly*, 101724. http://doi.org/10.1016/J.GIQ.2022.101724

Hollingsworth, B. (2008). The measurement of efficiency and productivity of health care delivery. *Health Economics*, *17*(10), 1107–1128. Retrieved from http://dx.doi.org/10.1002/hec.1391

Johnson, A., & Kuosmanen, T. (2015). An Introduction to CNLS and StoNED Methods for Efficiency Analysis: Economic Insights and Computational Aspects. *Benchmarking for Performance Evaluation*. Retrieved from http://link.springer.com/chapter/10.1007/978-81-322-2253-8_3

Kumbhakar, C., & Lovell, C. (2000). *Stochastic frontier analysis*. New York: Cambridge University Press.

Kumbhakar, S. C., Parmeter, C. F., & Zelenyuk, V. (2020). Stochastic Frontier Analysis: Foundations and Advances I. In C. Ray et al. (Ed.), *Handbook of production economics* (p. 40). Springer Nature Singapore Pte Ltd. 2021 S. http://doi.org/10.1007/978-981-10-3450-3_9-2

Kuosmanen, T. (2008). Representation theorem for convex nonparametric least squares. *Econometrics Journal*, *11*(2), 308–325. http://doi.org/10.1111/j.1368-423X.2008.00239.x

Lopez, M., Dollery, B., & Byrnes, J. (2009). An empirical evaluation of the relative efficiency of roads to recovery expenditure in New South Wales local government, 2005/06. *Australasian Journal of Regional Studies*, *15*(3), 311–328.

Meeusen, W., & Van den Broeck, J. (1977). Efficiency estimation from Cobb-Douglas production functions with composed error. *International Economic Review*, (8), 435–444.

Miller, G. J. (2005). The political evolution of principal-agent models. *Annual Review of Political Science*, *8*, 203–225.

Moe, T. M. (1984). The New Economics of Organization. *American Journal of Political Science*, *28*(4), 739.

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*. http://doi.org/10.1080/03003930.2017.1322958

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*. Delft: IPSE Studies.

Niaounakis, T. K., & Van Heezik, A. A. S. (2017). *Wegen gewogen. Een empirisch onderzoek naar de kosten en doelmatigheid van het decentrale wegbeheer tussen 2008 en 2014*. Den Haag/Delft: IPSE Studies.

NJI/PPRC. (2018). *Inkoop jeugdhulp door gemeenten: Hoe zit het? Facts & Figures*. Utrecht/Lunteren: Nederlands Jeugdinstituut/Public Procurement Research Centre.

Parmeter, C. F. (2018). Estimation of the two-tiered stochastic frontier model with the scaling property. *J Prod Anal*, *49*, 37–47. http://doi.org/10.1007/s11123-017-0520-8

Parmeter, C., & Kumbhakar, S. (2014). *Efficiency Analysis: A Primer on Recent Advances*. Miami, New York.

Ray, S. C., Kumbhakar, S. C., & Dua, P. (2015). *Benchmarking for performance evaluation: A production frontier approach*. *Benchmarking for Performance Evaluation: A Production Frontier Approach*. http://doi.org/10.1007/978-81-322-2253-8

Sappington, D. E. M. (1991). Incentives in Principal-Agent Relationships. *Journal of Economic*

Perspectives, *5*(2), 45–66.

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. http://doi.org/10.1016/j.childyouth.2015.09.018

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. http://doi.org/10.1111/j.1468-0084.2006.00158.x

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. http://doi.org/10.1023/A:1016565719882

Weber, M. (1958). *From Max Weber: Essays in Sociology*. New York: Oxford Univ. Press.

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