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DECLARED VS. REVEALED YARDSTICK COMPETITION: LOCAL GOVERNMENT EFFICIENCY IN NORWAY

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Declared vs. revealed yardstick competition: Local government efficiency in Norway

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Abstract

This paper investigates whether the production efficiency of Norwegian local governments exhibits a spatial pattern that is compatible with the hypothesis of yardstick competition. In order to check whether yardstick competition is really responsible for the observed spatial pattern, and to rule out alternative theoretical explanations, the paper exploits unique information from a survey on Norwegian local governments, where local public officials are explicitly asked whether they compare their own performances in the provision of public services to those of other governments (benchmarking). Merging the latter information - "declared" yardstick competition - with the observed interdependence in local efficiency measures - "revealed" yardstick competition - the paper provides evidence that comparative performance evaluation generates spatial auto-correlation in local efficiency indicators.

JEL classification: C21; H72; H73.
Key words: local government efficiency; yardstick competition; spatial auto-correlation.

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1

1 Introduction

A fast growing empirical literature - reviewed by Brueckner [15] and Revelli [33] - has focused in recent years on fiscal interaction among local governments, and has investigated the role of the location of jurisdictions in the process of local fiscal policy determination.

In particular, an increasingly popular argument for intergovernmental interaction rests on the hypothesis of "yardstick competition" (Salmon [36]). Yardstick competition theory is based upon the idea that an informational spill-over from the fiscal policies enacted in the neighborhood - typically, the tax burden imposed onto residents in nearby jurisdictions - affects the beliefs of an imperfectly informed electorate with respect to the competency and honesty of their own government. The electorate in a local jurisdiction would learn more about the quality and efficiency of their own administrators, by using other governments' performances as a yardstick (Besley and Case [8]). The presence of the informational externality would then generate correlation in policies among neighboring jurisdictions, by inducing local authorities to mimic each other's behavior.

The yardstick competition hypothesis has recently been tested in the empirical local public finance literature, by way of estimation of local policy reaction functions. The empirical evidence in the work of Ladd [27] for US counties, Case, Hines and Rosen [16] for US states, Heyndels and Vuchelen [25] for Belgian municipalities, Schaltegger and Kuttel [37] for Swiss Cantons, Solé Ollé [38] for Spanish municipalities, Bordignon, Cerniglia, Revelli [11] for Italian municipalities, and Bivand and Szymanski [9], [10], and Revelli [34] for UK local authorities seems in fact to suggest that local policy-makers do not set their fiscal policies in isolation, but tend to be affected by their neighbors' policies through local information spill-overs.

A typical problem that one encounters when analysing inter-governmental interaction, though, consists in identifying the theoretical model that is responsible for the observed spatial pattern, since alternative theoretical mod-

els (such as competition for mobile tax bases) can generate similar patterns of spatial dependence as yardstick competition (Brueckner [15]).

This paper aims at tackling the above problem by using information from a survey on Norwegian local governments, to verify whether yardstick competition is really responsible for the observed spatial pattern. The survey investigates in particular whether local public officials compare the performances of their own bureaus in the provision of local public services to those of other governments (benchmarking). We use that information ("declared" yardstick competition) to check whether active benchmarking on the part of local governments generates correlation among own and neighboring bureaus' levels of efficiency in delivering local public services ("revealed" yardstick competition).

Recent papers that have used similar survey information in a local government context are Ashworth and Heyndels [5], Dahlberg, Mörk and Ågren [18], Babcock, Engberg and Greenbaum [7] and Rattsø and Sørensen [32].

Ashworth and Heyndels [5] use data on Flemish local politicians' opinions about local tax rates, and find that tax policies in neighboring jurisdictions affect the perceived political cost of one's own property tax rate increase. Dahlberg, Mörk and Ågren [18] use Swedish survey data where voters and local politicians are asked about their preferences for local public services, and find that voters and politicians have significantly different preferences for local public services, with the latter wanting more to be spent on municipal services than the former. Babcock, Engberg and Greenbaum [7] use Pennsylvania school district survey data where boards and unions are asked which school districts are taken as referents in wage bargaining processes, and find that proximity and similarity in financial characteristics are the most important reasons for referent selection. Finally, Rattsø and Sørensen [32] use survey data from Norwegian local governments, and find that public sector employees are less willing to accept reforms than the rest of the population.

Moreover, this paper aims at adding to the existing empirical yardstick

3

competition literature, by using - similarly to Geys [23] for Belgian municipalities - an indicator of efficiency in local provision of public services.[1] In fact, efficiency in local public service provision is typically only implicitly addressed in the empirical yardstick competition literature, in the sense that information on local government efficiency is seldom available.[2] Overall tax burdens or public expenditure levels in own and other relevant jurisdictions are usually taken as the crucial fiscal variables that voters would take into account, in an attempt to gauge the size of rents appropriated by own policy-makers.

Clearly, such an approach is unsatisfactory for most real world examples of decentralised provision of crucial public services, such as education, health and welfare programs (Propper and Wilson [31]). In fact, in most of those instances either the overall level of local taxation or a raw measure of public expenditure is bound to be an imperfect indicator of local government efficiency and performance, due to differences in preferences that translate into different levels of quality of local public services, tax base disparities, and exogenous shocks to the costs of local public service provision over which decentralised governments have no control.

In this paper, we measure local performance by a unique indicator of overall efficiency in the production of local public services by Norwegian local governments (developed by Borge, Falch and Tovmo [14]). In particular, we test whether such efficiency measure shows a pattern of spatial autocorrelation that might be compatible with yardstick competition among local service providers.

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[1]A substantial body of theoretical and empirical literature - reviewed by Fried, Lovell and Schnidt [22] and De Borger and Kerstens [21] - has focused in recent years on efficiency in the production of local public services, and has mostly employed non-parametric methods - such as Data Envelopment Analysis (DEA) and Free Disposable Hull (FDH) - to establish a best-practice efficiency. Recent examples are De Borger et al. [20] and Athanassopoulos and Triantis [6].

[2]There is a large literature, though, on performance management and benchmarking in public organisations. See Courty and Marschke [17] and the references therein.

4

The rest of the paper is organised as follows. Section **2** sets up the basic theoretical framework for the empirical analysis, based on the principal-agent relationship between politicians and bureaucrats. Section **3** turns to the spatial specification and empirical implementation of the equation for the determination of efficiency in the production of local public services. Sections **4** and **5** present the data set and the estimation results respectively, and section **6** concludes.

2   Theoretical background

In line with previous work on local public service provision in Norway (Kalseth and Rattsø [26]), our empirical work is based on a theoretical principal-agent framework, where (welfare-maximizing) politicians are the principals, and (self-interested) bureaucrats are the agents. The hypothesis of self-interested agents has been central in analyzing public sector policy outcomes in the public choice literature. The first formal model of bureaucratic supply was Niskanen [30], who assumed that bureaucrats would maximize production, given the sponsors' willingness to pay for the public services. Later contributions (such as Moene [29]) have introduced more sophisticated models, where bureaucrats gain utility also from what is denoted by "discretionary profits" and includes, for instance, low effort and extra salaries, and which amount to productive inefficiency.

In a study on Norwegian local government, Kalseth and Rattsø [26] analyze administrative expenditure, and model spending determination as a game between bureaucrats and politicians. They assume that bureaucrats prefer overspending, while the final outcome is the result of a bargaining game, where the political leadership enters the bargain with a "community preference function." Borge, Falch and Tovmo [14] suggest a similar framework for their analysis of overall local government efficiency, where bureaucrats are assumed to have preferences for discretionary profits/inefficiency,

and the outcome is again the result of a bargaining game. Essential for the outcome of such bargaining games is the bargaining strength of those participating in the games, usually a bureau and the political leadership.[3]

Even in the absence of any bargaining power, however, the agents can extract discretionary profits if they are better informed about the production process and costs than the principal. In the presence of asymmetric information about the cost of providing local public services, it might be optimal for the principal to compare the service production in own municipality with the neighbors', as an attempt to evaluate the performance of the agent (Courty and Marschke [17]).

A similar theoretical framework is used to justify the emergence of yardstick competition among UK local governments by Bivand and Szymanski [9], [10], who consider the principal-agent relationship between local politicians (the principal) and public service providers - that can either be a public bureau or a private firm. They show that contracts based on comparative cost evaluation can give rise to yardstick competition among the agents, and result in spatial auto-correlation in the final cost of local public services (the costs of domestic garbage collection in the UK districts).

In the next section, we test whether the index of efficiency developed in Borge, Falch and Tovmo [13], [14] for Norwegian local governments exhibits a spatial pattern that is compatible with inter-governmental strategic interaction originating from yardstick competition in a framework of asymmetric information between local politicians and bureaucrats. In particular, if politicians compare the service production in own municipality with the outcome in neighboring municipalities as an attempt to evaluate the performance of the agents (the bureaucrats), we expect such comparative performance evaluation on the part of politicians to induce yardstick competition among the

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[3]There is a large literature that relates bargaining power of the political leadership to its strength (Roubini and Sachs [35]). Political strength is likely to be important to hold down the agency demand for discretionary profit, making strong political leaderships more able to pursue its optimal policy than weak political leaderships.

bureaus providing public services, and to generate spatial auto-correlation in local efficiency measures.

3 Empirical implementation

We test for yardstick competition among Norwegian local public service providers, by estimating an equation of local efficiency determination that allows for spatial auto-correlation among service providers.

The empirical model is intended to formalize the idea that, in the presence of principals (i.e., local politicians) using comparative performance evaluation of agents - that is, observing the efficiency outcomes and updating their expectations about the rent-seeking behavior of agents, based on the available information on the determinants of efficiency both in own and in neighboring jurisdictions, - then agents would be forced to compete with their neighbors, and spatial auto-correlation in efficiency would result (Bivand and Szymanski [9], [10]).

In particular, we will test whether, conditional on a set of observable "internal" determinants of efficiency (the variables in matrix X in equation (1) below), local efficiency indicators exhibit spatial auto-correlation:

$$e = X\beta + \eta \tag{1}$$

$$\eta = \rho W \eta + \varepsilon \tag{2}$$

where e is a $(n \times 1)$ vector of local efficiency indicators (based on the index of efficiency developed in Borge, Falch and Tovmo [14]), X is a matrix of exogenous variables (discussed in section **4** below), and ε is a $(n \times 1)$ vector of i.i.d. error terms, with $E(\varepsilon) = 0$ and $E(\varepsilon\varepsilon') = \sigma_\varepsilon^2 I$.[4]

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[4]In the following, our estimation procedure will rely on the further assumption of normal distribution for ε. The hypothesis of normality of ε is not strictly necessary, because OLS estimation of equation (1) yields consistent (though inefficient) estimates of β. However, we will mainly be interested in the size of parameter ρ.

Equation (2) describes a spatial process with auto-regressive parameter ρ, with $|\rho| < 1$ to ensure spatial stationarity, and spatial weights matrix $W = \{w_{ij}\}$, where w_{ij} is different from zero if jurisdictions i and j are "neighbors," and $w_{ii} = 0$ (Anselin [2]). Given that any inference on the spatial interaction pattern needs to rely on prior information on "neighborhood" composition (Manski [28]; Aronsson, Blomquist and Sacklén [4]), the matrix W is based here on the standard border-sharing criterion that has been widely used in the empirical local public finance literature (Revelli [33]). According to that criterion, the weight w_{ij} equals $\frac{1}{n_i}$ if jurisdictions i and j share a border, with n_i being the number of jurisdictions sharing borders with jurisdiction i, and equals zero otherwise. As a result, the neighborhood variable $(W\eta)$ takes the form of a weighted average of adjacent jurisdictions' "unexplained" efficiency levels.[5]

By modeling a spatial auto-correlation process in the error term - equation (2) - the above empirical model allows us to test whether the component of efficiency that cannot be explained by observable non-stochastic determinants (X) - and that can therefore be attributed to diversion of public revenues to rents - shows a spatial pattern (as in Bivand and Szymanski [9], [10]; and Bordignon, Cerniglia and Revelli [11]; [12]).[6]

Clearly, though, evidence of spatial auto-correlation in the error terms of an efficiency determination equation - that is, a significant estimate of ρ in equation (2) - might be caused by omitted variables that affect efficiency

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[5]The border-sharing criterion can be relaxed in a number of ways (see, among the others, Case, Hines and Rosen [16]), by attributing stronger weights to those neighbors that are more similar in terms of population size or settlement pattern. However, the results do not point to clearer interaction patterns than those based on pure adjacency (shown in tables 2 and 3), and - while available upon request - are consequently not shown. Moreover, the problem of identification of the spatial interaction pattern is typically exacerbated when employing neighborhood matrices that select neighbors based on similarity along characteristics that are highly correlated with the variable of interest (Manski [28]).

[6]Apart from theoretical considerations, the spatial error specification (1)-(2) outperforms also on empirical grounds - as shown in section **5** below - the most common alternative spatial specification that directly includes a measure of neighbors' efficiency (a spatial lag We) on the right hand side of equation (1) - Anselin [2].

and are spatially auto-correlated (such as, say, the organizational structure of the local bureau), or simply by shocks that hit nearby authorities (such as common macroeconomic conditions affecting all municipalities located within a region), and not by yardstick competition.

Consequently, we exploit survey information to ascertain whether the empirical evidence is compatible with yardstick competition. In particular, we use Norwegian local politicians' responses to a nation-wide survey conducted by the Ministry of Local Governments and Regional Affairs in 2002. Based on the survey responses, we build a dummy variable (denoted by d_{YC}) that equals 1 if local politicians assert that they evaluate the performance in the provision of local services in their own jurisdiction relative to those of other governments, and equals zero otherwise. We include such dummy variable in the efficiency determination equation (1), in order to first check - by estimating parameter θ in equation (3) below - whether we find a significant difference in the level of efficiency between the governments that use comparative performance evaluation, and those who do not:

$$e = X\beta + \theta d_{YC} + \eta \tag{3}$$

Moreover, we allow for an heterogeneous spatial pattern in equation (2) - parameter γ in equation (4) below - depending on whether local governments declare that they compare their own jurisdiction's performance in the provision of local public services to those of other governments:

$$\eta = (\rho + \gamma d_{YC})W\eta + \varepsilon \tag{4}$$

While a significant estimate of ρ in equation (2) - and in equation (4) - points to a spatial pattern that could simply be due to the presence of correlated shocks to efficiency that have no behavioral significance, a significant estimate of γ in equation (4) would suggest that the spatial process in the unobservables is not simply caused by correlated shocks, but is related to the rent-seeking behavior of local bureaucrats: when politicians use comparative

9

performance evaluation (that is, when $d_{YC} = 1$), the resulting tighter competition among bureaucrats will be picked by parameter γ, and will imply that shocks to efficiency in the neighborhood are transmitted to a higher extent to the jurisdictions that are engaged in benchmark comparisons.

We estimate model (1)-(2) and model (3)-(4) by maximum likelihood methods that explicitly account for the spatial auto-regressive nature of the error term (Anselin [1]).

It must be admitted that the dummy variable d_{YC} might not be exogenous with respect to efficiency in local service provision in equation (3). First, governments that are more concerned with efficiency might be more prone to use "benchmarking" and at the same time be more likely to select good and efficient bureaucrats, thus generating a spurious positive correlation between the benchmarking decision and the level of efficiency. On the other hand, it might also be the case that "inefficient" bureaucrats be more likely to be subject to performance comparisons than efficient ones, thereby generating a spurious negative correlation between the benchmarking decision and the level of efficiency.

As a result, we do not attribute any causal effect to the yardstick competition dummy onto efficiency, but simply employ it to ascertain whether it is associated with heterogeneous interaction patterns in the efficiency measure.

As far as the role of the yardstick competition dummy in the spatial error process (4) is concerned, a spurious correlation between η and $W\eta$ would emerge if efficiency and benchmarking are correlated *and* the dummy d_{YC} is itself spatially auto-correlated. However, a Moran test for spatial auto-correlation in d_{YC} reveals no evidence that benchmarking jurisdictions be more likely to be surrounded by benchmarking ones, suggesting that the estimate of γ will not simply be reflecting the spatial location of benchmarking governments.[7]

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[7]The Moran test takes on the value of 0.06, with a z value of 1.4.

4 The data set

The hypotheses outlined above will be tested on cross-section data from Norwegian local governments in 2002. While at the time there were 434 municipalities in overall Norway, the high incidence of missing data either as regards the measure of efficiency or the responses to the survey makes estimation of the spatial model on the entire local government system problematic.[8] In particular, fewer local governments reported complete data in the northern regions of the country, and northern municipalities have on average fewer neighbors than their counterparts further south in the country, due to larger units in terms of acreage. As a result of the above difficulties, the efficiency determination model is estimated on the local governments that are located in the 12 counties in the southern part of Norway (205 localities).

The measure of efficiency (e) is the one recently developed by Borge, Falch and Tovmo [14], relating local government service production to income, in such a way that efficiency can be interpreted as "getting maximum amount of production for a given income."

The measure of production is an aggregate indicator of service production developed by Borge, Falch and Tovmo [13], which is later reported annually in reports from the "Advisory Commission on Local Public Finance" in Norway. The aggregate measure consists of 20 indicators comprising the production in six sectors. On average, the expenditures in those sectors account for more than 80 percent of total expenditures.[9]

Production is then related to local government income, that is deflated by an index capturing variation in costs of service production. The index used in the needs equalization system - capturing variation in population size, settlement pattern, social factors and demographic composition - is the

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[8]In fact, compared to conventional models, missing observations are a more dramatic problem in spatial models, since the methods of estimation will break down if at least one unit has no neighbors (Anselin [1]).

[9]A detailed description of the production measure can be found in Borge, Falch and Tovmo [14].

point of departure. Thereafter, a settlement pattern which is expected to increase the cost of production will reduce income. This measure of economic conditions is published annually by the Ministry of Local Governments and Regional Affairs and is generally accepted as the most reliable measure of variation in economic conditions across Norwegian local governments. In addition, the index applied here controls for variation in labour costs caused by differential rates of payroll taxes (set by central government) across local governments.

The matrix of exogenous variables X includes local government revenues, characteristics of the local political leadership, and variables capturing structural characteristics of local government service production.[10] The latter variables are the rate of unemployment, the size of population and two variables describing the settlement pattern in the municipalities: average travel distance to the municipality center and population density.[11]

The strength of political leadership is measured by a Herfindahl index of party fragmentation of the local council which is frequently applied in studies of Norwegian local governments, for instance Kalseth and Rattsø [26] and Borge, Falch and Tovmo [14]. The index is defined as:

$$h = \sum_{p=1}^{P} sh_p^2 \qquad (5)$$

where sh_p is the share of council seats held by party p $(p = 1, ..., P)$. The idea is that a fragmented council constitutes a weak leadership, implying a positive connection between the index and strength.

Ideology of the leadership is included in the model as well. There is evidence that socialist influence increase wages (Strøm [39]) and administrative spending (Kalseth and Rattsø [26]). Both will have a negative impact on

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[10]Borge, Falch and Tovmo [14] found a non-linear impact of revenues of efficiency, so we follow their approach and include also a squared term.

[11]While those variables are already accounted for in the efficiency index, we include them in the efficiency equation to allow for a less restrictive impact of structural characteristics on the process of efficiency determination.

our efficiency measure, and we measure ideology by the percentage share of council seats that are held by representatives from socialist parties.

Descriptive statistics for all variables used in the empirical analysis are displayed in table 1. To facilitate interpretation, efficiency is normalized to 100, and deviations from the mean can thus be interpreted as percentage deviation. Similarly to efficiency, the measures of revenues and population size are also normalized to 100.

Finally, information on the attitude of local politicians towards comparative performance evaluation ("declared yardstick competition") is derived from the database "*Organisasjonsdatabasen.*" The database includes a wide set of data on local government organization, that were collected in several surveys conducted by the Norwegian Institute for Urban and Regional Research (NIBR). One of the topics covered by the database is to which extent the municipalities utilize "market mechanisms" to improve efficiency and quality of the service production.

In particular, local governments are asked whether they aim at increasing knowledge and improving own performance by "systematically comparing the performance in specific units with own past performance, with the performance of other comparable units in their own municipality or with other local governments."[12] Furthermore, the survey goes into more detail, by asking local governments to specify which activities (out of 15) are subject to such benchmarking. We attribute the value of 1 to the dummy d_{YC} if local governments said they were engaged in benchmarking in at least one of those activities.[13]

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[12]110 out of 205 local governments responded to the survey, and a little more than 50 percent of the respondents stated that they use benchmarking as a means of improving performance. In the empirical analysis, non respondents are treated as non-benchmarking.

[13]No local government stated that only one service was subject to benchmarking. Two alternative ways of constructing the dummy were tried, but the results were not much affected. The first was a dummy taking the value of one if at least five sectors were subject to benchmarking. The second was a dummy that equals one if the three largest services included in the efficiency measure (kindergartens, primary education and care for elderly) were subject to benchmarking. The correlation between the measure applied and

5 Results

Tables 2 and 3 present the main estimation results of the efficiency determination equation, based on a border-sharing and row-standardized spatial weights matrix.

Column (a) of table 2 presents benchmark OLS estimation results of a parsimonious non-spatial specification - equation (1). Column (b) presents the results from OLS estimation of equation (1) when including the dummy variable d_{YC} and further explanatory variables on the right hand side of the equation.

The lower part of column (a) of table 2 reports the results of the Moran test on the OLS residuals from the non-spatial specification (a) and of the two robust LM tests (developed by Anselin et al. [3]) for a spatial lag of the dependent variable (LM-lag) - that is, a test on the direct inclusion of neighbors'efficiency (We) on the right hand side of equation (1) - and for a spatial process in the error term (LM-error) - equation (2). The tests suggest that, even after controlling for local exogenous characteristics (the variables in matrix X), the measure of efficiency shows a significant tendency for positive spatial auto-correlation. The Moran test - that is distributed as a standard normal (Anselin [1]) - allows us to confidently reject the null of no spatial auto-correlation, while the robust LM tests for a spatial lag alternative and a spatial process in the error term suggest that the latter specification should be preferred. Consequently, column (c) presents maximum likelihood estimation results of the model with spatial auto-correlation in the errors - equations (1)-(2).

The OLS estimation results in column (a) of table 2 confirm the findings of Borge, Falch and Tovmo [14], with significant negative impact on efficiency from revenues and population density. The results with respect to the political variables show that political strength has a positive effect and the share

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the two alternatives were 0.60 and 0.97, respectively.

of socialist seats in the council has a negative (but not significant) effect on efficiency.

Column (b) reports OLS estimates of an equation that allows for a non-linear effect from revenues and population, and also includes two additional variables reflecting the economic structure of the locality - average travel distance to the centre of the municipality and the rate of unemployment - and the dummy variable that equals one for the governments reporting that they actively compare their own service provision to other governments'. The results reveal a significant non-linear impact of revenues, that is negative in the relevant range of the revenue variable, and whose absolute size is increasing with revenues. At means values, a one percent increase in revenues will reduce efficiency by 0.15 percentage points. Also population size has an overall negative impact on efficiency in the relevant range of the variable. On the other hand, the estimated coefficient θ on the dummy d_{YC} turns out not to be significantly different from zero.

Column (c) reports estimates of the spatial auto-regressive model (1)-(2). The spatial auto-regressive coefficient ρ is estimated to be positive, but hardly statistically significant at conventional levels; moreover, the likelihood ratio test (reported at the bottom of column (c)) with respect to a model that constrains ρ to be zero suggests that the restriction $\rho = 0$ does not lead to a dramatic decrease in likelihood.

Analogous results appear in table 3 - column (d) - that reports estimates of equation (3), while allowing for the spatial error structure in (2), with an (imprecise) estimate of ρ of about 0.16.

On the other hand, columns (e) and (f) of table 3 show estimates of model (3)-(4), that uses information from the survey data and includes the dummy d_{YC} in the spatial error process, therefore allowing for heterogeneous interaction patterns, depending on the survey responses.

Unlike the result in the specification in column (d), the LR test results at the bottom of columns (e) and (f) reveal a significant increase in likelihood

15

when the spatial process in the error term is allowed to depend upon the dummy variable d_{YC} as in equation (4). In particular, it turns out that the ρ coefficient - as well as the θ coefficient on the dummy variable in equation (3) - is not significantly different from zero, while γ is estimated to be large and highly statistically significant (a point estimate of about 0.7).

The above result means that an increase in efficiency of 1 percentage point in the neighborhood prompts an efficiency increase of 0.7 percentage points in the jurisdictions that are actively engaged in benchmarking with neighboring governments ($d_{YC} = 1$), but has no effect whatsoever on the remaining governments.

Overall, the above evidence is compatible with the hypothesis that the spatial pattern in efficiency is really driven by some form of yardstick competition: spatial interaction turns out to be negligible for those governments that declare that they are not engaged in yardstick comparisons (parameter ρ), while spatial auto-correlation is strong and significant for those governments that declare they compare their performances to those of other governments (parameter γ). Moreover, it is noticeable that those results are not affected by whether or not the dummy variable d_{YC} is included in the efficiency determination equation - columns (e) and (f) respectively.

6   Concluding remarks

This paper has investigated whether the efficiency of Norwegian local governments - measured by the index of efficiency developed in Borge, Falch and Tovmo [14] - exhibits a spatial pattern that is compatible with the hypothesis of yardstick competition. In order to test whether yardstick competition is really responsible for the observed spatial pattern, and to rule out alternative theoretical explanations, the paper has exploited unique information from a survey on Norwegian local governments, where local governments are explicitly asked whether they compare their own performance in the provision of

16

public services to those of other governments (benchmarking).

The results show that spatial auto-correlation in efficiency among local jurisdictions is best explained by a spatial error dependence model. Moreover, when employing survey data it comes out that significant spatial auto-correlation occurs only for those jurisdictions whose governments declare that they compare their own public service provision to those of relevant governments. The above result suggests that the observed spatial auto-correlation in efficiency levels is not simply driven by correlated shocks, but is instead compatible with local performance comparisons (benchmarking) generating yardstick competition among public service providers.

Acknowledgements

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Table 1 Data definition and descriptive statistics

Variable	Description	mean (std. dev)
efficiency	efficiency index	100 (9.5)
revenues	exogenous own revenues plus grants	100 (13.2)
population	total resident population	100 (263.1)
population density	number of inhabitants per square kilometre	80.7 (175.9)
Herfindahl index	Herfindahl-index of council fragmentation	24.5 (6.4)
% socialist	share of representatives from socialist parties	35.7 (13.1)
settlement pattern	average travel distance to municipality center	1.3 (0.9)
unemployment	rate of unemployment	2.2 (0.8)

Notes:

Data sources: KOSTRA (Municipality-state-reporting) and Norwegian Science Data Services (NSD).

<p style="text-align:center">Table 2   The determinants of efficiency</p>

	(a)	(b)	(c)
revenue	-0.405 (9.26)	0.929 (2.58)	0.955 (2.62)
revenue^2 (/1000)		-6.037 (4.02)	-6.170 (4.07)
population	-0.001 (0.43)	-0.016(2.69)	-0.016 (2.69)
population^2 (/1000)		0.0049 (2.68)	0.0050 (2.85)
population density	-0.013 (3.27)	-0.432 (1.22)	-0.347 (0.93)
Herfindahl index	0.407 (4.09)	0.291 (3.31)	0.292 (3.36)
% socialist	-0.087 (1.85)	-0.036 (0.85)	-0.052 (1.12)
settlement pattern		0.358 (5.51)	0.353 (5.39)
unemployment		1.008 (1.67)	0.956 (1.50)
θ		-0.515 (0.47)	
ρ			0.168 (1.59)
estimation method	OLS	OLS	ML
R^2	0.35	0.54	
Moran test (p value)	2.56 (0.01)		
LM-lag$_{[d.o.f]}$ (p value)	1.87$_{[1]}$ (0.17)		
LM-error$_{[d.o.f]}$ (p value)	5.58$_{[1]}$ (0.02)		
LR test$_{[d.o.f]}$ (p value)			2.47$_{[1]}$ (0.12)
observations	205	205	205

Notes

1) dependent variable: efficiency index (Borge, Falch, Tovmo [14]);

2) t statistics in parentheses;

3) the Moran test test is based on the OLS residuals from the non-spatial specification (a), and is distributed as a standard normal $z(0,1)$;

4) LM-lag and LM-error tests are based on the OLS residuals from the non-spatial specification (a);

5) the LM and LR tests are distributed as χ^2.

Table 3   The determinants of efficiency: heterogeneous spatial patterns

	(d)	(e)	(f)
revenue	0.954 (2.61)	1.033 (2.89)	1.040 (2.91)
revenue^2 (/1000)	-6.164 (4.06)	-6.488 (4.35)	-6.517 (4.37)
population	-0.016 (2.82)	-0.016 (2.64)	-0.017 (2.93)
population^2 (/1000)	0.0050 (2.72)	0.0050 (2.96)	0.0050 (3.01)
population density	-0.344 (0.93)	-0.304 (0.84)	-0.314 (0.84)
Herfindahl index	0.291 (3.21)	0.287 (3.31)	0.290 (3.31)
% socialist	-0.052 (1.12)	-0.018 (0.42)	-0.172 (0.38)
settlement pattern	0.353 (5.36)	0.357 (5.61)	0.357 (5.61)
unemployment	0.957 (1.43)	1.004 (1.63)	0.992 (1.57)
θ	-0.129 (0.05)		0.640 (0.54)
ρ	0.165 (1.48)	-0.043 (0.31)	-0.043 (0.31)
γ		0.684 (2.42)	0.721 (2.66)
estimation method	ML	ML	ML
LR test$_{[d.o.f]}$ (p value)	2.48$_{[2]}$ (0.29)	7.96$_{[2]}$ (0.02)	8.24$_{[3]}$ (0.04)
observations	205	205	205

Notes

1) dependent variable: efficiency index (Borge, Falch, Tovmo [14]);

2) t statistics in parentheses;

3) LR test is distributed as χ^2.

24