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Quality Investment and Price Formation in the Performing Arts Sector: A Spatial Analysis

by Stefan Traub

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Quality Investment and Price Formation in the Performing Arts Sector: A Spatial Analysis

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Abstract: In this paper, we present a spatial model of the public provision of the performing arts. Agents behave boundedly rational. Art directors set performance quality according to their aspiration levels. While taking into account the spatial distribution of the population, administrative directors in calculating ticket prices ignore that they compete with neighboring performing arts organization (PAOs) for audience. The model is tested empirically using a spatial autoregressive (SAR) model with a complete data set of German PAOs and cities. Our data support the model and help to explain the size and distribution of losses in the public performing arts sector.

Keywords: Performing Arts, Local Public Goods, Quality, Spatial Competition, Bounded Rationality

JEL Classification: H41, R59, Z10

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1 Introduction

In times of public money shortage, it is not too astonishing that subsidization of the performing arts is a hotly debated issue in countries possessing a significant public performing arts sector such as France, Germany and the UK.[1] A glance at the "official" statistics of Germany's 151 public theaters published by the Deutscher Buehnenverein (2002) reveals that the sector received public subsidies amounting to 2.1 billion € in the 2001/02 season. On the other hand, box office returns and other revenues covered only 16.1 % of the theaters' total operating costs. These figures correspond to a subsidy of 96 € per ticket sold — this is a large amount set in relation to an average ticket price of less than 11 €. Moreover, the 26 million seats offered by German theaters in the course of the season attracted not more than 19 million spectators, equivalent to a utilization of capacity of less than 75 %.

Since Baumol and Bowen's (1966) seminal book "Performing Arts: The Economic Dilemma" the economics of the performing arts has progressed a lot. The vast transfer of public funds into the performing arts sector has triggered a debate not only on the causes but also on the economic justification of subsidization in general. We do not want to embark on this debate here but refer to Throsby's (1994) and Blaug's (2001) surveys on cultural economics for details. Understandably, as the subject started with Baumol's "cost disease" hypothesis, this literature focusses primarily on costs structures in the performing arts sector and on the extent of possible externalities of the performing arts for the benefit of the society.

Relatively little attention has been paid so far to the behavior of the

[1]In contrast to their European counterparts US performing arts organizations are normally financed by private donations rather than public subsidies. For such models see the classical papers by Hansmann (1981) and Steinberg (1986).

relevant decision makers on the supply side of the performing arts market, i.e., the local politicians and the managers of the performing arts organizations (henceforth abbreviated PAO). A notable exemption to this is Krebs and Pommerehne (1995) who studied the interactions between demand for the performing arts, grantors of public funds and PAO managers in a public choice framework. Their theoretical and empirical analysis suggests that PAO managers are biased towards artistic goals and therefore aspire after a large share of "highbrow productions", being constrained, however, by public decision makers who make the grant of subsidies contingent on capacity utilization. Schulze and Rose (1998) analyzed local politicians' decision behavior with respect to performing arts subsidization using a data set for 49 German symphony and chamber orchestras.

Seaman (2004) pointed to a further aspect of the performing arts sector that has largely been neglected so far. As empirical research has shown that operating a PAO involves huge fixed costs,[2] most authors have taken for granted that the performing arts can be seen as a natural monopoly. Hence, (spatial) interaction between PAOs in terms of competition for public funds, audience etc., is an understudied domain.[3]

This paper is an attempt to fill some of these gaps. We present a positive

[2]Diminishing average costs in the provision of seat capacity were documented, for example, by Baumol and Bowen (1966) for US symphony orchestras, Globerman and Book (1972, 1977) for Canadian theaters and orchestras, Lange et al. (1985) and Lange and Luksetich (1993) for Australian symphony orchestras, Gray (1992) for Norwegian theaters, Hjorth–Andersen (1992) for Danish theaters and Krebs (1996) for German theaters.

[3]In contrast to this, a large body of literature exists on competition among local public governments with respect to a large array of parameters such as local tax competition and the provision of local public goods. For a recent game–theoretic analysis of spatial competition in the investment on public facilities see Takahashi (2004). See also the literature stated therein.

analysis of the performing arts sector. Taking up Blaug's (2001) plead for more models "in the spirit of 'bounded rationality' and 'muddling through' " (p. 132), we consider the behavior of some of the agents involved in the public provision of the performing arts. The art director sets performance quality according to her aspiration level. Given the quality investment of the art director, the administrative director seeks to minimize the PAO's losses,[4] thereby ignoring that she competes with other PAOs for audience. We explicitly take into account the spatial structure of the performing arts sector, i.e., the distribution of PAOs and their potential audiences on the map. The model is tested empirically using a spatial data set of all German PAOs and municipalities. Indeed, administrative directors seem to take into account the spatial distribution of the population in calculating ticket prices by allowing for travel costs; yet our data supports our initial hypothesis that they largely ignore competition. It is shown that, in zones where the sales areas of PAOs overlap, those PAOs that take higher ticket prices than their neighbors make higher losses. Furthermore, our parameter estimates suggest that the art director invests too many funds in quality.

The paper is organized as follows. In the next Section, we present the theoretical model. The model is tested empirically in Section 3. Section 4 concludes the paper.

[4] With this respect our model is similar to Hansmann's (1981) model of US performing arts organizations. Hansmann shows that a quality-maximizing non-profit firm chooses the audience size (via the price) that maximizes its net revenue. The difference is that we replaced quality-*maximizing* by quality-*satisfying* behavior.

2 The Model

Spatial Structure

We consider a country comprising N large cities U_i, $i \in \mathcal{L} = \{1, \ldots, N\}$, and n small cities u_r, $r \in \mathcal{S} = \{1, \ldots, n\}$. Large cities are inhabited by M_i citizens; small cities exhibit a population of m_r. The spatial location of large and small cities is denoted by G_i and g_i, respectively, where locations are vectors of latitude and longitude. PAOs are exclusively operated by large cities due to cost reasons. Furthermore, we assume that every large city operates exactly one public facility, i.e., we do not study intra-city competition.[5] Citizens of small cities have to commute to large cities in order to utilize their services. It is assumed that commuters are constrained in their reach by time and travel costs, where b denotes the maximum reach of a citizen in kilometers or miles, respectively.[6] $d_{r,i}$ denotes the distance between small city r and large city i.[7]

We define:

Definition 1 (Commuter Belt) *Large city i's commuter belt is given by the set of small cities $\mathcal{B}_i = \{u_r : d_{r,i} \leq b, r \in \mathcal{S}\}$.*

and

[5] However, in the empirical part of the paper, we control for possible effects of intra-city competition.

[6] Note that we implicitly assume independence of maximum reach and ticket price. This is admittedly unrealistic but keeps the model tractable.

[7] Assuming that Earth is a perfect globe, the distance between small city u_r and large city U_i is given by $d_{r,i} = D \times \arccos[\sin(\ell a_r)\sin(\ell a_i) + \cos(\ell a_r)\cos(\ell a_i)\cos(\ell o_i - \ell o_r)]$, where D has to be replaced by 6378.399 kilometers or 3954.607 miles, respectively, and ℓa and ℓo stand for latitude and longitude in degrees.

Definition 2 (Choice Set) *Small city r's choice set is given by the set of large cities* $\mathcal{C}_r = \{U_i : d_{r,i} \leq b, i \in \mathcal{L}\}$.

Let $\#\mathcal{C}_r$ denote the size of r's choice set. In what follows, we consider only small cities with $\#\mathcal{C}_r > 0$, that is, with nonempty choice set. Obviously, if $\#\mathcal{C}_r \geq 2$, the commuter belts of two or more large cities must overlap, establishing spatial links between large cities.

Definition 3 (Spatial Link) *A spatial link between any two large cities i and j exists if* $\mathcal{B}_i \cap \mathcal{B}_j \neq \emptyset$, *that is, there is at least one small city* u_r *such that* $\{U_i, U_j\} \subseteq \mathcal{C}_r$.

Cost Function

Performing arts organization is an umbrella term for both a public facility (buildings, technical equipment, etc.) and its administration and management. As to the more technical side, we assume that the facility provides a particular service — theatrical performances, where the term theater henceforth is used in a generic sense for all performing arts such as theaters, operas, operettas, musicals, and ballets. In order that the service can be experienced by the audience, it is necessary that a facility, usually a playhouse, exists. While it may be an interesting problem apart to study the capacity choice of the facility, we assume that the facility's capacity, in terms of seats, is exogenously given by $\bar{Z}_i$. Since a playhouse is needed to "consume" a performance, potential attendants are easily excluded from consumption at the theater's entrance door or box office. Moreover, additional spectators do not harm present attendants' consumption as long as ticket demand does not exceed the facility's capacity limit.[8] Seen from this perspective, the performing arts

[8] Note that this is only a simplifying assumption. Traub and Missong (2005) modelled the performing arts as a congestible public good. For the same data set, they obtained an

can be considered as an excludable public good.

The problem of quality choice of publicly supplied goods has been studied with many different connotations of the term quality, and the same quality connotation can be modelled differently. For example, one could define "goods of different quality as different goods" (Bös et al. 1982, p. 289). Modelling quality as product differentiation is an approach that was taken by Hohaus et al. (1994) in a Hotelling model of local public goods supply. In contrast to this, Bös et al. (1982) captured quality differences, for example, by a quality indicator (see also Spence 1975). Our own approach resembles that of Bös et al. insomuch as we measure quality by a (nonnegative real–valued) index number Q_i.

But how can we fill such an index in a sector like the performing arts where quality is perhaps more central than elsewhere? Studies on the perception of quality in the performing arts sector are numerous. The classical reference to this is Throsby and Withers (1979) who compiled a large catalogue of qualitative output measures such as the source material, the technical standard of a performance and its benefits to the audience, the society and the specific form of art. Throsby (1990) used press reviews, i.e., expert opinions, to assess the quality of three theater companies in Sydney. In a recent econometric study, Tobias (2004) linked expert opinions to economic data on public theaters. He found that dimensions that do not correlate with economic variables (e.g. the esthetic orientation of the expert) were more important for quality judgements in drama than in ballet or opera.

In this paper, we solely concentrate on quality dimensions that are cor-

estimate of 0.85 for the rate of capacity utilization (loading) that minimizes congestion and, due to the fact that the marginal provision costs of seat capacity were larger than the individual marginal congestion costs, a socially optimal loading of 100%.

related with economic variables. To be more specific, we assume that quality has K physically measurable or otherwise quantifiable dimensions θ_k, $k = 1, \ldots, K$, which are all *positively related to costs*. Let $\bar{\theta}_k$ denote the mean quality with respect to dimension k. We choose $Q_{i,k} = \theta_{i,k}/\bar{\theta}_k$ and define the quality of U_i's theater by

$$Q_i = \prod_k (Q_{i,k})^{\nu_k}, \quad \text{where } \nu_k > 0 \; \forall \; k \text{ and } \sum_k \nu^k = 1. \tag{1}$$

Due to our definition of the $Q_{i,k}$'s, we have — unattached by the dimension weights ν_k — $Q_i = 1$ if a theater is of average quality with respect to all K dimensions.

The marginal use costs of the public facility are negligible. Hence operating costs are determined by the constructional capacity $\bar{Z}_i$ of the facility rather than output in terms of tickets sold Z_i, and by quality Q_i. We assume that the cost function takes the form

$$C_i = C\left(\bar{Z}_i, Q_i\right) = C_0 Q_i^{\psi_1} \bar{Z}_i^{\psi_2}, \tag{2}$$

where $C_0 > 0$ is a scaling factor, and $\psi_1, \psi_2 > 0$ are the cost elasticities with respect to quality and capacity, respectively.

Theater Management

In order to model the theater management's bias towards artistic goals (see Krebs and Pommerehne 1995), we distinguish between the art director who sets Q_i, and the administrative director who sets the ticket price P_i. Note that both functions could unite in one person with lexicographic preferences concerning, in that order, quality and ticket returns. The art director behaves boundedly rational as her only goal is to satisfy an aspiration level $\bar{Q}$ without taking into account the city's budget constraint.[9]

As capacity is given and quality is out of the administrative director's control, her task is simply setting P_i to maximize ticket revenues $R_i = P_i Z_i$ (i.e. to minimize the facility's losses). Let Π_i denote U_i's profits:

$$\Pi_i = P_i Z_i - C_i. \tag{3}$$

Unfortunately, ticket revenues will generally not suffice to cover the relatively high fixed costs. Thus, the losses of the PAO have to be covered by subsidies.

Like in the case the art director, the administrative director's rationality is limited. She takes the spatial structure of her sales area only partly into account by completely ignoring spatial links between large cities. Hence, the administrative director acts as if "her" small cities were belonging exclusively to the consumer belt of her city. In other words, she perceives her city as a spatial monopolist.

Definition 4 (Spatial Monopolist) *A city U_i is called a spatial monopolist if $\mathcal{B}_i \cap \mathcal{B}_j = \emptyset \, \forall \, j \in \mathcal{L}/i$.*

Note that the rationality limits of the administrative director result from a simple miscalculation, which may even be intended, rather than an aspiration level and that this kind of behavior, therefore, may best be characterized as "muddling through" (see Blaug 2001).

Both directors are hired by the mayor of the city. For simplicity, we assume that all administrative directors are identical and that there are enough administrative directors to equip all PAOs. Since quality is costly, the city

[9] Compare Simon (1955). The aspiration level concept was developed by Lewin and his collaborators (Lewin et al. 1944). Siegel (1957) defined the level of aspiration as the "least upper bound of that chord connecting two adjacent points on a (discontinuous) utility scale that has the maximum slope".

hires a specific art director from a continuum of art directors only if it can "afford" her aspiration level, and the art director will stay only if she is provided with enough funds to reach her aspiration level. In the equilibrium, we therefore have $Q_i = \bar{Q}_i \; \forall \; i$. The factors that make an aspiration level affordable for a particular city are not within the scope of our model. It is assumed, however, that the art director with the least aspiration level would already overstrain a small city with raising enough tax money to cover their facilities' losses. Therefore small cities do not operate own PAOs.

Demand

Let us assume that the administrative director is right in assuming that she is a spatial monopolist. In order to make the model empirically testable, we consider in calculating ticket demand the inhabitants of a hypothetical small city that is located in average distance Δ^i from U_i

$$\Delta^i \equiv \frac{\sum_{r:u_r \in \mathcal{B}_i} m_r d_{r,i}}{M_i + \sum_{r:u_r \in \mathcal{B}_i} m_r} \tag{4}$$

and assume that travel costs are covered by a markup factor on the ticket price

$$t_i = \exp\left(\gamma \Delta^i\right), \tag{5}$$

where $\gamma > 0$ and, of course, $t_i \geq 1$.

As citizen have no choice between different theaters, they base their decision on whether or not to use "their" theater on the local quality adjusted consumer price

$$\tilde{P}_i = P_i \bar{Q}_i^{-\beta} t_i, \tag{6}$$

with $\beta > 0$. Note that the choice of this particular form of the markup factor best suits our purpose to make the model empirically testable. It implies that the elasticity of the local quality adjusted consumer price with respect to distance increases in distance $\eta_{\tilde{P}_i,\Delta^i} = \gamma\Delta^i$.

Within the representative city citizens are heterogenous with respect to their willingness–to–pay for an admission ticket. The WTP is denoted by ζ and it is assumed that ζ has the density function $f(\cdot)$ and the cumulative distribution function $F(\cdot)$. Accordingly, the probability that a citizen buys a ticket price is given by $1 - F\left(\tilde{P}_i\right)$. For city U_i's ticket demand, we get

$$Z_i = \left(M_i + \sum_{r:u_r\in\mathcal{B}_i} m_r\right)\left[1 - F\left(\tilde{P}_i\right)\right]. \tag{7}$$

Remember that (7) is valid only if U_i is indeed a spatial monopolist as taken for granted by the administrative director.

Loss Minimization

In order to compute the revenue maximizing ticket price, we assume that ζ is either uniformly distributed on the interval $[0, \bar{\zeta}]$, where $\bar{\zeta}$ is the maximum WTP, or exponentially distributed on the interval $[0, \infty)$. In the former case we get

$$f(\zeta) = \frac{1}{\bar{\zeta}}, \tag{8}$$

$$F(\zeta) = \frac{\zeta}{\bar{\zeta}}, \tag{9}$$

$$Z_i = \left(M_i + \sum_{r:u_r\in\mathcal{B}_i} m_r\right)\left(1 - \frac{\tilde{P}_i}{\bar{\zeta}}\right) \tag{10}$$

and, after maximizing R_i,

$$P_i^{\text{uni}} = \frac{1}{2}\bar{\zeta}\bar{Q}_i^{\beta}\exp(-\gamma\Delta^i). \tag{11}$$

In the latter case, we have

$$
\begin{aligned}
f(\zeta) &= \lambda \exp(\lambda\zeta) && (12)\\
F(\zeta) &= 1 - \exp(-\lambda\zeta) && (13)\\
Z_i &= \left(M_i + \sum_{r:u_r\in\mathcal{B}_i} m_r\right) \exp\left(-\lambda\tilde{P}_i\right) && (14)
\end{aligned}
$$

and

$$P_i^{\exp} = \frac{1}{\lambda}\bar{Q}_i^{\beta} \exp(-\gamma\Delta^i). \qquad (15)$$

Note that both $\bar{\zeta}/2$ and $1/\lambda$ represent the mean WTP μ, irrespective of whether we assume ticket demand to be a linear function as in (11) or unbounded from above and nonlinear as in (15). Accordingly, we can write

$$P_i^{\exp} = \mu\bar{Q}_i^{\beta} \exp(-\gamma\Delta^i). \qquad (16)$$

Ceteris paribus, PAOs charge higher prices if (i) the mean WTP is higher, (ii) the quality of their services is better, and (iii) the population lives nearer to the center of the consumer belt. In both setups, the consumer price equals the mean WTP

$$\tilde{P}_i = \mu. \qquad (17)$$

There is an interesting relationship between the parameters ψ_1 from the cost function and β from the demand function that would remain valid even if Z_i had to be adjusted for spatial links. Let $\eta_{\Pi,Q}$ denote the elasticity of the profits (losses) with respect to quality. It is straightforward to show that

$$\eta_{\Pi,Q} \begin{cases} < 0 & \text{if} \quad \beta < \psi_1 \\ = 0 & \text{if} \quad \beta = \psi_1 \\ > 0 & \text{otherwise.} \end{cases} \qquad (18)$$

Only in the intermediate case, quality is at its optimum level. If quality is too low, the marginal cost increase from improving quality is less then what could additionally be earned by stimulating demand. Most likely, however, is the first case in which quality is set to a level too high as compared to the optimum.

So far, we have only modelled what the administrative director believes to be the demand function. She is right if she actually is a spatial monopolist. However, if there are spatial links between large cities, (rational) citizens will commute to that PAO that exhibits the lowest net price as to their location. Then, expected ticket demand

$$
\begin{aligned}
Z_i^{\text{uni}} &= 0.5 \times \left(M_i + \sum_{r:u_r \in \mathcal{B}_i} m_r \right) \\
Z_i^{\text{exp}} &= 0.368 \times \left(M_i + \sum_{r:u_r \in \mathcal{B}_i} m_r \right)
\end{aligned}
$$

is obviously only an upper bound for actual ticket demand. Moreover, the PAO will suffer unexpected losses.

3 Empirical Test

Empirical Model

We obtain the structural parameters of the cost function by taking the log of (2), adding an error term $\varepsilon_{1,i}$ and estimating

$$
\ln C_i = \ln C_0 + \psi_1 \sum_k \nu_k \ln \bar{Q}_{i,k} + \psi_2 \ln \bar{Z}_i + \varepsilon_{1,i} \tag{19}
$$

by OLS. Let $\hat{\beta}_{1,k} = \widehat{\psi_1 \nu_k}$ denote the estimated coefficient for quality dimension k. Due to $\sum_k \nu_k = 1$, we can easily compute $\hat{\psi}_1$ and $\hat{\nu}_k$:

$$
\hat{\psi}_1 = \sum_k \hat{\beta}_k, \tag{20}
$$

$$
\hat{\nu}_k = \frac{\hat{\beta}_k}{\sum_\ell \hat{\beta}_\ell}\,. \tag{21}
$$

For estimating the parameters of the price functional we set up the following spatial autoregressive (SAR) model:

$$\ln P_i = \varrho \mathbf{W}_i \ln \mathbf{P}' + \ln \mu + \beta \ln \hat{Q}_i - \gamma \Delta^i + \varepsilon_{2,i}. \tag{22}$$

Besides from the term $\varrho \mathbf{W}_i \ln \mathbf{P}'$, equation (22) is the log of the facility manager's price functional (11) or (15), respectively. Irrespective of whether we assume uniform or exponential preference, estimating the log–version of either equation gives us an estimate of the mean WTP for tickets $\hat{\mu}$. Furthermore, we obtain estimates for the elasticity of the ticket price with respect to quality $\hat{\beta}$ and distance $\hat{\gamma}$. Note that in equation (22), the log of the quality index estimated in

$$\ln \hat{Q}_i = \sum_k \hat{\nu}_k \ln Q_{i,k} \tag{23}$$

enters the regression.

$\mathbf{W}_i$ is the ith row vector of the spatial contingency matrix $\mathbf{W}$, which is given by

$$\mathbf{W} = \begin{bmatrix} 0 & \omega_{1,2} & \cdots & \omega_{1,N} \\ \omega_{2,1} & 0 & \cdots & \omega_{2,N} \\ \vdots & \vdots & \ddots & \vdots \\ \omega_{N,1} & \omega_{N,2} & \cdots & 0 \end{bmatrix}. \tag{24}$$

The single elements of $\mathbf{W}$ are determined by

$$\omega_{i,j} = \frac{\sum_{r:u_r \in (\mathcal{B}_i \cap \mathcal{B}_j)} m_r}{\sum_{s:u_s \in \bigcup\limits_{j \in \mathcal{L}/i} (\mathcal{B}_i \cap \mathcal{B}_j)} m_s} \tag{25}$$

and add up to one row–wise

$$\sum_j \omega_{i,j} = 1. \tag{26}$$

$\mathbf{P} = (P_1, P_2, \ldots, P_N)$ is the price vector. Hence, the scalar $\mathbf{W}_i \ln \mathbf{P}'$ is the log of the weighted mean ticket price of the neighbors of municipality i. The larger the population living in the intersection between the commuter belts of cities' i and j, the higher the respective weight.

Since OLS delivers biased and inconsistent estimates, equation (22) was estimated using Anselins' (1988) four step procedure.

The Data

The data we used has been drawn from four sources: the statistical yearbook of the German association of performing arts organizations (Deutscher Buehnenverein 2002), season 2001/02, the statistical yearbook of German municipalities edited by the German conference of cities (Deutscher Staedtetag 2000), the municipal tax rate statistics jointly published by the federal and state statistical offices (Statistische Aemter des Bundes und der Laender 2000) and ORTREF, a commercialized data set containing the geo–coordinates of all German municipalities.

First, we settled differences between ORTREF and the list of municipalities provided by statistical offices, which were mainly due to amalgamations of municipalities in East Germany, by matching both data sets by means of the municipalities' unique key numbers. This left us with a data set of 13841 German municipalities. For each municipality, we recorded key number, city name, population as of June 2000 (M_i and m_r, respectively) as well as longitude (ℓo) and latitude (ℓa).

Second, we compiled a data set for all German municipalities exhibiting at least one PAO. If there was more than one PAO, the respective data was pooled, i.e., we consider locations rather than single PAOs as we do not intend do model competition for audience within municipalities. This data set consists of the capacity $\bar{Z}_i$ of the PAO (the number of seats multiplied with the number of performances added up for all PAOs if multiple), the number of tickets sold Z_i, the number of different stagings (NOS), the operating returns R_i (ticket sale, wardrobe fees and program fees) as well as operating costs C_i, the average yearly gross wage of a member of the art personnel (WAP), computed as the total art personnel costs divided by the size of the art personnel, and the relative share of the total subsidies received by the PAO that are borne by the taxpayers of the respective municipality itself (SAD). The statistical yearbook of German municipalities lists for all German municipalities exhibiting more than 10,000 inhabitants (fortunately, all municipalities with a PAO have been larger) the following variables that additionally entered the data set: per capita income tax returns (INC) and age profile (AGE), computed as the number of people in a old people's home over the number of kindergarten places. The data set also contained dummy variables for East German municipalities, the presence of a university at the location and the presence of multiple PAOs. Note that we excluded theaters for children from our data set as competition between theaters for children and adults is probably very weak if at all. This left us with 137 PAOs at 110 locations.

Then, we programmed an algorithm that computed for each "large" municipality the prevailing average ticket price P_i (total operating costs over ticket demand), the distance of a hypothetical average commuter Δ^i according to equation (4) and the weighted ticket price of the neighbors $\mathbf{W}_i \ln \mathbf{P}'$. We repeated the algorithm seven times for a maximum reach of $b \in \{20, 25, 30, 35, 40, 45, 50\}$ kilometers.

Results

First, we report the results of estimating the cost function. Table 1 contains descriptive statistics of the data entering the regression. We considered three quality dimensions in estimating the dimension weights ν_k and the elasticity of the costs function with respect to quality ψ_1:

1. The giftedness of the actors, as measured by the average gross wage of the artistic personnel (WAP).

2. The lavishness of the stagings, as measured by population size of the (POP).

3. The broadness of the repertoire, as measured by the number of different stagings per season (NOS).

As can be taken from the table, the sample mean of WAP was about 52,000 € per year. The average theater city had a population of about 230k. On average, on a location not less than 37 different stagings were offered per season (NOS). Furthermore, the average capacity (CAP) was slightly lower than 240k.

Insert Table 1 about here

Table 2 shows the results of estimating the cost function using OLS with White's heteroscedasticity consistent covariance matrix. As can be taken from the bottom of the table, the overall fit of the regression is satisfactorily high.

Insert Table 2 about here

As explained above, the weights for giftedness (WAP), lavishness (POP) and broadness (NOS) add up to one. Broadness is assigned the largest weight of about 0.6, while giftedness and lavishness, respectively, exhibit a weight of about 0.2. However, the estimate for WAP is insignificant. We attribute this to the fact that the variance of the average wage of the artistic personnel is very small (see Table 1) as all engagements at public theaters are subject to the Normalvertrag Buehne, the collective wage agreement in Germany's performing arts sector. For the elasticity of the cost function with respect to quality (QUA), we obtained an estimate of 0.856, i.e., an increase of quality by one percent leads to a cost increase of slightly less than one percent. The estimate for the elasticity of the cost function with respect to capacity (CAP) shows that a capacity increase generates a cost increase less than proportional.

Table 3 shows the results of estimating the administrative director's price functional with the log ticket price $\ln P_i$ as the endogenous variable. At the top of the table, the radius of the commuter belt is given, i.e., the maximum reach of a citizen b. For $b < 50$, the number of observations (locations) entering the analysis is smaller than 110 as some large cities do not have any spatial links. For each radius b the table reports the results of four regressions. Regression I is the initial model without spatial correlation. As it is to be expected that the mean WTP for a ticket depends on the demographics of the city, we included in regression II and IV three additional explanatory variables: income (INC), subsidies (SAD) and age distribution (AGE). These variables entered the regression linearly. Hence, the structural parameter mean WTP is the product of its components

$$\hat{\mu} = \hat{\mu_0} \prod_{\ell} \mu_\ell D_\ell, \tag{27}$$

where $D_\ell \in \{INC, SAD, AGE\}$, and the estimated parameters μ_ℓ are elasticities. Models III and IV include the spatial autoregressive term.

For all regressions, the fit is satisfactorily high. The initial model explains about 50 % of the variance. Adding the demographics increases the fit by some 5 percentage points, while there is only a small increase in the coefficient of determination when adding the neighbors' prices.

In all regressions, the mean WTP is positive and significant. In model I it is between 12 € and 16 €. According to models II and IV the income elasticity of the WTP for theatrical performances is positive but lower than unity. An increase in income by 1 € leads to an increase of the mean WTP of about 0.25 €. Note that we also tried a dummy variable for the East German cities in the regression. However, as income is much lower in the East German cities than in the western part of the country, we had to omit the dummy for multicollinearity reasons. We expected a negative sign for SAD as a higher share of subventions to be paid from own tax money should lead to lower net income and, thus, to lower demand. Indeed, we get a negative sign for μ_{SAD}, but the estimates are insignificant in all regressions. Econometric demand studies show that young parents usually do not have the time and the resources to spend their money on theater tickets. Though insignificant in all but three regressions, the estimates for AGE are positive as hypothesized.

Insert Table 3 about here

Quality has a very strong impact on price. $\hat{\beta}$ is significant at the 1 % level in all regressions. Our estimate of about 0.4 suggests that the administrative director takes a price 0.4 % higher if the art director increases quality by 1 %. Remember that our estimate of the corresponding quality elasticity of the cost function is given by $\hat{\psi}_1 = 0.856$. As $\hat{\psi}_1 > \hat{\beta}$ (the t test is significant at the 1 % level), we can conclude that the level of quality chosen by the art director is distinctly too high. The cost increase induced by the last marginal unit of quality brought about a cost increase more than twice as large as the corresponding increase in ticket returns.

The last structural parameter of our model, the distance parameter $\hat{\gamma}$ is significantly different from zero in about half of the regressions and only in those with relatively small b. Note that γ enters the regression (22) negatively, i.e., the estimated parameters have, except for large b, the right sign. An estimate of $\hat{\gamma} = 0.03$ in model I with $b = 20$ means that the administrative director would allow for travel costs between 0 % (if all spectators were living in the city center) and 82 % (if all households were living at the outside margin of the commuter belt) in fixing the ticket price. The relationship between distance and ticket price deteriorates for larger b probably because the administrative director focusses only on the closest (small) neighbor cities.

The correlation parameter $\hat{\varrho}$ is insignificant for all regressions below a radius of 35 km. Above that value APC is significant in model III (except for $b = 40$); but this influence vanishes if income and the other demographic variables are taken into account (model IV). Thus, at least for small maximum reach, we can draw the conclusion that administrative directors do not fully take into account the spatial dimension of their decision problem. Though they take into account their clients' travel costs when calculating ticket prices, the ignore the fact that other theater managers compete with them for the same audience. For a large radius of the commuter belt, the evidence is mixed. In some regression, there is a positive spatial correlation between ticket prices. A comparison of models III and IV, however, suggests that price differences are driven by income differences rather then the average ticket price of the neighboring PAOs, i.e., in high–income regions the average price level is relatively high anyway.

Dummy variables for university towns and cities with multiple PAOs had to be omitted, since the presence of both a university and several PAOs is highly correlated with population size and, thus, one of our quality dimensions.

It remains to answer the question whether the administrative director's failure to recognize that she competes with her colleagues for audience is economically relevant at all. Obviously, if there are spatial links, which means that those people who live in the intersections have to choose between two or more theaters, at least one administrative director will overestimate her revenue. Three factors influence demand: ticket price, quality and travel cost. Let us assume that, for the choice between two or more theaters, travel costs are irrelevant because all commuters that have a choice live exactly in the center of the intersection of the commuter belts. Then, those PAOs charging relatively high quality adjusted ticket prices will experience relatively high losses.

Insert Table 4 about here

Table 4 lists the average operating loss per offered seat for (real) spatial monopolists and for competing PAOs that are either cheaper or more expensive than their neighbors with respect to (a) the ticket price set by the administrative directors and (b) the quality adjusted ticket price. Analysis of variance (ANOVA) shows that, in most cases, losses are significantly different from one another. Spatial monopolists have the lowest losses per seat. Note that, as noted above, the number of spatial monopolists decreases as b increases. As hypothesized, competing PAOs that offer their admission tickets for a price lower than the weighted average of the neighbors, make relatively low losses. For example, given a maximum reach of 35 km, monopolists on average suffer losses of 52 € per seat, cheap competing PAOs exhibit a loss of 66 € per seat and expensive competing PAOs exhibit a loss of almost 93 € per seat. This demonstrates that demand actually reacts to differences in quality and ticket prices. Accordingly, bounded rationality and "muddling through" on the theater managements' side can at least partly explain the size and distribution of losses in the performing arts sector.

4 Conclusion

We have presented a positive analysis of the public provision of the performing arts. In our model, agents behave boundedly rational. Art directors set performance quality according to their aspiration levels. While taking into account the spatial distribution of the population, administrative directors in calculating ticket prices ignore that they compete with neighboring performing arts organization (PAOs) for audience. The model has been tested empirically using a spatial autoregressive (SAR) model with a complete data set of German PAOs and cities.

Our empirical results suggest that art directors invest too many resources in quality. As the marginal costs of quality are distinctly higher than the marginal revenue generated by quality, a general reduction of the level of quality in the performing arts sector would reduce the sector's losses (and thus the necessity to subsidize) significantly. It should be noted that our notion of quality is strictly related to production costs. Hence, a cut in quality investment does not necessarily mean a loss of esthetic quality or social relevance of the repertoire. On the whole, we also find our hypotheses concerning the behavior of the administrative directors confirmed. Administrative directors adjust ticket prices for quality and travel costs but ignore competition. Our subsequent analysis of the PAOs' losses has shown that this kind of "muddling through" behavior is not without economic consequences. Theaters with relatively high price levels suffered higher losses than their neighbors.

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Tables

Table 1 The Cost Function — Descriptive Statistics

Label	Var	Mean	Std.Err.
WAP	$\bar{Q}_1$	52,399 €	1,584 €
POP	$\bar{Q}_2$	229,273	37,152
NOS	$\bar{Q}_3$	37.55	2.62
CAP	$\bar{Z}$	239,189	28,439

Table note. $n = 110$.

Table 2 The Cost Function — OLS Estimation

Label	Parameter	Coefficient	Std.Err.	Sig.Level
SCA	$\hat{C}_0$	7,431	6,991	.288
WAP	$\hat{\nu}_1$	.193	.156	.217
POP	$\hat{\nu}_2$	.195	.063	.002
NOS	$\hat{\nu}_3$	.612	.135	.000
QUA	$\hat{\psi}_1$	.856	.113	.000
CAP	$\hat{\psi}_2$	.635	.076	.000
$n = 110$	$\bar{R}^2 = .908$	$F_{4,105} = 269.65$		$P(F) = .000$
Log–L$= -29.568$			Breusch–Pagan: $\chi^2_4 = 22.170$	

Table note. Standard errors are corrected for heteroscedasticity (White estimator).

Table 3 The Administrative Directors Price Functional

Radius b km (miles)		20.0 (12.4)				25.0 (15.5)			
# observations		67				87			
Label	Parameter	I	II	III	IV	I	II	III	IV
WTP	$\hat{\mu}_0$	15.10***	4.31**	13.86***	4.38***	14.11***	4.17**	12.49***	4.10**
		(2.27)	(2.28)	(3.21)	(1.88)	(2.04)	(2.02)	(2.91)	(1.60)
INC	$\hat{\mu}_{INC}$	—	.249***	—	.253***	—	.217***	—	.226***
			(.071)		(.067)		(.064)		(.059)
SAD	$\hat{\mu}_{SAD}$	—	-.020	—	-.028	—	-.005	—	-.013
			(.019)		(.025)		(.015)		(.021)
AGE	$\hat{\mu}_{AGE}$	—	.157	—	.153	—	.085	—	.079
			(.146)		(.130)		(.119)		(.108)
QUA	$\hat{\beta}$	.432***	.386***	.426***	.385***	.421***	.385***	.421***	.386***
		(.069)	(.075)	(.074)	(.070)	(.065)	(.063)	(.067)	(.064)
DIS	$\hat{\gamma}$	.030*	.041**	.033*	.040**	.017	.017	.018	.017
		(.017)	(.018)	(.019)	(.024)	(.012)	(.012)	(.013)	(.013)
APC	$\hat{\varrho}$	—	—	.049	-.024	—	—	.059	-.023
				(.082)	(.077)			(.076)	(.074)
	$\bar{R}^2$	.537	.605	.540	.606	.502	.558	.506	.559
	F	39.25***	21.25***	37.57***	18.81***	44.37***	22.69***	32.87***	20.57***
	Log–L	-10.28	-3.31	-94.23	-87.35	-10.58	-3.85	-130.89	-124.31

Continuation of Table 3

Radius b km (miles)		30.0 (18.6)				35.0 (21.7)			
# observations		99				105			
Label	Parameter	I	II	III	IV	I	II	III	IV
WTP	$\hat{\mu}_0$	16.62***	3.58**	14.11***	3.54**	16.62***	3.27**	10.86***	3.13**
		(2.60)	(1.81)	(3.74)	(1.54)	(2.96)	(1.56)	(3.07)	(1.33)
INC	$\hat{\mu}_{INC}$	—	.257***	—	.270***	—	.271***	—	.256***
			(.070)		(.063)		(.067)		(.062)
SAD	$\hat{\mu}_{SAD}$	—	-.004	—	-.010	—	-.005	—	-.006
			(.016)		(.022)		(.013)		(.021)
AGE	$\hat{\mu}_{AGE}$	—	.134	—	.128	—	.126	—	.125
			(.129)		(.106)		(.122)		(.101)
QUA	$\hat{\beta}$	.381***	.373***	.388***	.370***	.380***	.366***	.393***	.371***
		(.071)	(.067)	(.072)	(.067)	(.069)	(.065)	(.071)	(.068)
DIS	$\hat{\gamma}$	.024**	.015	.023*	.015	.020*	.013	.018	.012
		(.011)	(.011)	(.012)	(.012)	(.010)	(.008)	(.011)	(.010)
APC	$\hat{\varrho}$	—	—	.064	-.035	—	—	.169**	.051
				(.080)	(.079)			(.083)	(.084)
	$\bar{R}^2$	.445	.519	.450	.521	.435	.521	.465	.523
	F	40.27***	22.16***	39.36***	20.24***	40.96***	23.59***	44.37***	21.75***
	Log–L	-22.43	-2.44	-165.68	-157.22	-23.38	-13.14	-176.59	-168.33

Continuation of Table 3

Radius b km (miles)		40.0 (24.9)				45.0 (28.0)			
# observations		107				109			
Label	Parameter	I	II	III	IV	I	II	III	IV
WTP	$\hat{\mu}_0$	15.70***	3.25**	10.60***	3.14**	15.32***	3.08***	10.71***	2.96***
		(3.09)	(1.52)	(3.34)	(1.37)	(3.17)	(1.45)	(3.56)	(1.34)
INC	$\hat{\mu}_{INC}$	—	.268***	—	.263***	—	.274***	—	.271***
			(.065)		(.061)		(.075)		(.059)
SAD	$\hat{\mu}_{SAD}$	—	-.003	—	-.006	—	-.004	—	-.007
			(.013)		(.021)		(.014)		(.021)
AGE	$\hat{\mu}_{AGE}$	—	.151	—	.151	—	.179	—	.180*
			(.117)		(.098)		(.110)		(.094)
QUA	$\hat{\beta}$	.396***	.378***	.407***	.381***	.407***	.393***	.422***	.397***
		(.074)	(.070)	(.074)	(.071)	(.075)	(.071)	(.078)	(.074)
DIS	$\hat{\gamma}$	.014	.008	.012	.007	.011	.005	.010	.004
		(.009)	(.008)	(.010)	(.010)	(.009)	(.007)	(.010)	(.009)
APC	$\hat{\varrho}$	—	—	.158*	.024	—	—	.142	.021
				(.092)	(.093)			(.095)	(.097)
	$\bar{R}^2$	.426	.515	.448	.516	.427	.524	.442	.524
	F	40.37***	23.54***	42.27***	21.54***	41.21***	24.73***	42.06***	22.69***
	Log–L	-23.75	-13.16	-181.56	-172.49	-24.57	-12.94	-186.81	-176.26

Continuation of Table 3

Radius b km (miles)		50.0 (31.1)			
# observations		110			
Label	Parameter	I	II	III	IV
WTP	$\hat{\mu}_0$	12.00***	2.37**	7.43***	2.23**
		(2.59)	(1.17)	(2.64)	(1.05)
INC	$\hat{\mu}_{INC}$	—	.282***	—	.271***
			(.065)		(.060)
SAD	$\hat{\mu}_{SAD}$	—	-.006	—	-.008
			(.013)		(.021)
AGE	$\hat{\mu}_{AGE}$	—	.184*	—	.188**
			(.108)		(.092)
QUA	$\hat{\beta}$	.467***	.445***	.483***	.450***
		(.074)	(.073)	(.078)	(.075)
DIS	$\hat{\gamma}$	.001	-.004	.000	-.003
		(.008)	(.008)	(.009)	(.008)
APC	$\hat{\varrho}$	—	—	.194*	.053
				(.102)	(.108)
	$\bar{R}^2$	.420	.523	.445	.524
	F	40.53***	24.90***	42.94***	22.98***
	Log–L	-24.99	-12.71	-188.54	-177.92

Table 4 Loss per Ticket by Price — ANOVA

b (km)		Spatial monopolist	Cheaper	More expensive than neighbors	F
20	a	70.24	74.68	78.15	.545
		(3.86)	(7.32)	(5.34)	
	b	70.24	70.53	86.89	2.417*
		(3.86)	(6.22)	(5.45)	
25	a	67.08	71.03	81.43	1.741
		(5.36)	(5.56)	(4.60)	
	b	67.08	69.15	88.47	4.265**
		(5.36)	(4.88)	(4.69)	
30	a	61.68	69.68	83.06	2.952*
		(7.89)	(4.79)	(4.31)	
	b	61.68	68.20	89.66	6.031***
		(7.89)	(4.31)	(4.31)	
35	a	52.18	69.26	82.72	3.446**
		(7.66)	(4.64)	(4.12)	
	b	52.18	66.26	92.55	10.002***
		(7.66)	(3.89)	(4.61)	
40	a	46.13	71.67	79.04	1.781
		(12.24)	(4.81)	(3.63)	
	b	46.13	68.07	90.47	6.987***
		(12.24)	(3.91)	(4.35)	
45	a	68.96	68.90	80.80	1.781
		(.)	(4.68)	(3.83)	
	b	68.96	67.68	90.02	5.542***
		(.)	(3.83)	(4.50)	
50	a	—	68.00	82.63	5.461**
			(4.55)	(3.64)	
	b	—	67.74	90.66	11.594***
			(3.74)	(4.61)	

Table notes. First row: loss per ticket; second row: standard errors. (a) ticket price; (b) quality adjusted ticket price.