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Output Characteristics and Other Determinants of Theatre Attendance—An Econometric Analysis of German Data

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Abstract

The purpose of this paper is to test the sensitivity of theatre attendance in Germany to a number of unique output characteristics of the performing arts, as well as the usual economic variables of price and income. This is made possible by the availability of an exceptionally rich data set relating to the very large theatre sector in Germany. The econometric results indicate that the output characteristics used do impact significantly on theatre attendance in Germany and possibly more so than any of the usual standard economic variables. This suggests that theatre, and the performing arts in general, are indeed "different" and that analysis of demand functions for them should take more account of output-characteristic factors.

Keywords: Theatre Attendance, Output Characteristics, Quality, Germany

JEL Classification: Z11, L32, L82, D12

1. Introduction

The purpose of this article is to measure the effects that ticket price, income and a subset of various output characteristics of the performing arts have on theatre attendance in Germany. In fact, this is the first article to look at such a broad range of output characteristics, some of which have not been used before in any study. The first group of output characteristics relates to the quality of artistic output and includes the reputation of the theatre, as measured by attendance at guest performances as a proportion of total attendance, and the average outlay on artistic personnel and on décor and costumes. The other three output-characteristic variables examined are a theatre's propensity to stage new productions, average staff-complement size, and its output mix across different forms of theatre (drama, opera, musicals, etc). Additionally, we examine the impacts of factors such as total theatre

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capacity, market size and the number of other theatres in the market which may be relevant for theatre demand.[1]

The rich data set used (4,254 observations), relating to West German theatre from 1965 / 1966 to 1989 / 1990 (25 years) and German theatre from 1990 / 1991 to 2004 / 2005 (15 years), will also allow relatively accurate estimation of price and income elasticities of demand for theatre, taking into account these output-characteristic determinants, perhaps more reliable than any previous estimates. Estimation of demand functions using panel data offers a number of advantages. First, it allows for control for unobserved heterogeneity of theatres and thus offers a potential solution to the problem of omitted-variables bias. Second, it also allows for dynamic adjustment of the demand function and can accommodate endogenous regressors, an important concern when modelling price and quality.

The paper is divided into seven sections. Section 2 will review briefly relevant previous literature in relation to the impact of quality and output characteristics on theatre attendance. Section 3 will discuss the sources and nature of the data sets used and comment briefly on aspects of the organisational structure of German theatre of most relevance to the construction of the model. Section 4 will discuss at some length the dependent and independent variables used. The empirical model is presented in Section 5. Section 6 presents the key results, in terms of descriptive statistics and econometric estimates, and Section 7 concludes the paper.

2. Output Characteristics and Theatre: Relevant Previous Literature

While Moore (1966) conducted a statistical analysis of the determinants of theatre attendance, the main pioneering work on this topic was undertaken by Withers (1977 and 1980). Withers (1980) was conscious of the effects of quality change on the demand for the performing arts but argued that "no convincing adjustment seems possible" to take account of this factor. Thus the importance of quality, and hence of output characteristics, in determining theatre attendance was recognised but considered too difficult to measure.

Globerman and Book (1974) had considered the issue of quality in the *supply* of the performing arts and used statistical measures to capture this. These included a diversity index and the average pay of artistic personnel. Throsby (1983) outlined a range of possible quality factors that might affect demand for the performing arts. In particular he considered repertoire classification and standard of source material and production, and of acting and design. To measure these he used a "condensation of press reviews" to provide a cardinal 1 – 5 scale. As the author was fully aware, the empirical work was "exploratory" and the data set very limited, with

[1] Thus, we are drawing on previously-used variables but also in most cases applying new variables and hence new measures.

data only for three theatres for a five-year period. Nonetheless, this was the first serious attempt to address the issue of quality in relation to demand for the performing arts, although many of the factors considered were in fact output characteristics and not related to quality per se (see later).[2]

Abbé-Decarroux (1992) chose to "improve our understanding of the role of quality in consumer choice for services" by studying "the demand for performing arts which provide a relevant case, particularly amenable to empirical analysis" (p. 99). He used variables to measure quality similar to those of Throsby (1983) but applied his analysis to just one theatre company, covering 64 productions spread over seven years. The construction of the quality variables was again subjective. One novel aspect of this paper was the division of quality factors into those which can be observed in advance and others which are hard to evaluate before seeing the performance. Thus he allowed in his model for the fact that the consumer has incomplete information and cannot be sure in advance of the quality of the service, no matter what reviews he / she has read.[3]

In recent years, more extensive attempts have been made to incorporate quality factors as determinants of theatre attendance, using explicit and less subjective measures and much more extensive data.[4] Werck and Heynels (2007) and Werck et al. (2008) correctly indicated that some of the quality variables looked at previously were "output characteristics," not related necessarily to quality but which could influence attendance. They concentrated on output characteristics related to programme choice, such as playwright, whether a new, old, or adapted production, average cast size, etc. Zieba (2009) was the first paper since Withers (1980) to

2 Gapinski (1984) was mainly concerned with estimating production functions but also had a short section on estimating demand. His data related to the Royal Shakespeare Company in England using just 30 observations, but this is still one of the most thorough studies examining demand for the performing arts, particularly in relation to price and income. This paper made no reference to Moore (1966) or Withers (1980).

3 This is in contrast say to buying a car, where quality may be a hugely important factor but the consumer can test-drive the car in advance or try out a friend's car and read reliable quality assessments provided through different sources.

4 There have been a number of other studies of theatre demand since, but none of these really address the issues of price, income, and quality simultaneously and besides in some cases rely on rather unreliable data sources for estimation. Nonetheless some of these studies provide interesting discussions of various issues and are worth consulting. For example, Lévy-Garboua and Montmarquette (1996) used a large arts attendance survey at a point in time in France to examine the determinants of theatre attendance but the findings were either inconclusive or not convincing, and there were no usual price or income elasticities estimated. Urrutiaguer (2002) addressed the issue of quality judgements and their measurement in some detail but his data set, relating also to France, did not really allow him, as he pointed out, to come up with any conclusive findings with regard to the effects of output characteristics or other economic variables. He did look at some interesting new indicators of quality, such as type of theatre director and level of public subsidy. Tobias (2004) looked at the issue of quality and supply. He provided an interesting framework for aggregating expert opinion about theatre, but his empirical work had to depend on only a very small number of responses to his self-administered questionnaire, with a less than 15 per cent response rate.

estimate leisure-price effects using data on German public theatres and it also drew on the work by Toma and Meads (2007) in this regard, and on Werck and Heyndels (2007), in relation to quality as a determinant of the demand for German theatre.[5]

3. Key Features of, and Data on, German Theatre

3.1 Data Sources

A knowledge of the basic features of the German theatre sector is important to understanding the inclusion of some variables in the later regression analysis (see for example Hofmann (1998) and Krebs (1996) for overviews of the German theatre sector). The major statistical source for the German theatre sector is the yearly *Theaterstatistik (Theatre Statistics Report*) which has been prepared for the Federal Republic of Germany since 1945, for the German Stage Association (*Deutscher Bühnenverein*) and for two governmental institutions–the German Association of Cities and Towns (*Deutscher Städtetag*) and the Cultural Commission of Education Minister (*Kunstausschuss der Kultusministerkonferenz*). The main aim of these reports was and is to simplify and unify the statistical data for public theatres. Following the theatres' request for regular access to *Theaterstatistik*, the German Stage Association has published the statistics every year since 1965. The statistics are published for every season from October till September of the following year. The layout of *Theaterstatistik* has not changed substantially since 1965 which enables comparison of data over time.[6]

The data sets used for this study relate to 93 public theatres from the former West Germany from 1965 / 1966 to 1989 / 1990 and 170 (106 theatres from former West Germany and 64 theatres from former East Germany) German public theatres for the period 1990 / 1991 to 2004 / 2005.[7] While this very rich data source was used for the first time by Zieba (2009), it is being used here for very different purposes and with many different / extra variables included.[8]

5 This paper uses a different dependent variable and more extensive output-characteristic variables to those used in Zieba (2009), the focus of whose paper was leisure-price effects. The current paper also takes account of capacity constraints and breaks the analysis into two periods, covering West German theatre from 1965 / 1966 to 1989 / 1990 and all German theatre from 1990 / 1991 to 2004 / 2005. It also discusses and tests more fully for endogeneity.

6 Some changes were introduced in *Theaterstatistik* for 2004 / 2005. For this theatre season the data had to be aggregated in a few cases to enable comparison with previous years.

7 There are no comparable data available for the former East German theatres prior to 1990 / 1991.

8 A few econometric investigations of demand were conducted based on the data for German public theatres but they related to a shorter time period (see for example Krebs, 1996, and Tobias, 2004) or to aggregate data for all German public theatres (Krebs and Pommerehne, 1995). Neligan (2006) used data from one year of *Theaterstatistik* to examine the issue of repertoire conventionality in relation to German theatre. Schulze and Rose (1998) also used this source, in their case in relation to orchestras.

3.2 Organisational Structure

Public theatres in Germany are located in about 122 cities, with around 721 theatre venues and seating for circa 253,000 persons. They are owned by the federal region or municipality or a combination of both (Hofmann 1998) and are subsidised by their licence holders in the form of covered deficits (see O'Hagan (1998), for a brief history of performing arts institutions in Germany and elsewhere in Europe). There are about 230 large private theatres and around 2,030 small private theatres, which are called "free theatres" and which in general do not receive any subsidises. The private theatres may be in competition with public theatres, at least in large cities.

Public theatres are not wholly funded by the state but must earn revenues on the market through ticket sales. Thus, public theatres aim to maximise revenues but subject to the constraint that certain non-private benefits to society are also achieved (O'Hagan 1998). As such, the focus of this paper is just on public theatre, given its different emphasis, repertoire, and funding structure to private theatre.[9]

Some final pieces of information are of relevance to the later regressions. German public theatres can be described as *Dreispartentheater* (three-branch theatres) meaning that many produce not just drama, but also musical theatre (opera / operetta / musical) and ballet / dance theatre. This implies that a variety of performing arts forms are generally offered by a single theatre enterprise.[10] In addition, about 82 orchestras are integrated with the public theatres; the orchestra's main task arises in relation to musical theatre but they also stage stand-alone concerts. In major cities, however, for example Berlin, Dortmund, Hamburg, or Munich, the branches of theatre tend to be separate.[11]

German public theatres are also described as "repertory" theatres. It means that the performances of each production listed in the repertoire are spread over the theatre season, which lasts 12 months including ten months of staging artistic productions and two months of preparations and rehearsals for the next season. As opposed to "en suite" theatres, German public theatres play regularly during the whole season and the production programme is prepared and published at the beginning of the season. There are up to 20 – 25 new productions in a season at large theatres and there are few evenings when the same production is repeated.[12]

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9 *Theaterstatistik* includes theatre attendance data for German large private theatres, but there are no data available which would be relevant to construct ticket price and the output characteristics variables.

10 Occasionally puppet theatre and childrens' & youth theatre are also provided. As such, German public theatre can also be termed *Mehrspartentheater* (multiple-branch theatre).

11 In Hamburg, for instance, there are two municipal drama theatres and one municipal opera house.

12 See Zieba and Newman (2007) for a discussion of other features of the German theatre sector which relate more to the production side, the focus of their paper.

4. Determinants of Theatre Attendance[13]

4.1 Dependent Variable

Aggregate paid attendance is the relevant dependent variable, where A_{jt} is attendance at theatre j in season t. Seaman (2006) and Zieba (2009) contain discussions of the relevant measure of theatre demand, but in almost all studies it is the level of total attendance that is used. In this study it is attendance at each public theatre, which means total attendance at all venues in each theatre. It also includes attendance at guest performances away from the public theatre in question. Thus, what we are measuring is demand for (namely paid attendance at) all activities of each public theatre.

Panel data consists of time series data on many theatres, in this case over 170 theatres. Capacity constraints in this context could have an important impact on theatre attendance. Over time this is unlikely to be an important factor as capacity varies little. In relation to examining theatres at a point in time though, clearly the capacities of the theatres examined vary considerably and as such this could be an important factor in explaining demand *across* theatres. In this case it might be argued that a better dependent variable might be attendance divided by capacity. The model then reduces to explaining capacity utilization and not attendance. As a result, in this paper total capacity, C_{jt}, is instead included as an independent variable, thereby allowing us to identify the impact of other variables taking into account total capacity of each theatre.[14]

In this context it is interesting to ask what is meant by total capacity. It could be the total number of seats multiplied by the maximum number of possible performances, in other words maximum *possible* supply. As the maximum number of possible performances would not vary across time or across theatres, then the total number of seats would pick this up. However, the number of *actual* performances does vary across time and across theatres and as such *effective* supply is measured then by total number of seats multiplied by actual number of performances. This is the variable used in this study.[15]

This raises issues though as to whether or not effective supply is being adjusted in response to demand. That this is the case is probably true but with a time lag. The number of performances are decided in advance and do not vary in response to current attendance, but this number may be set taking into account trends in past attendance. As such, there is unlikely to be any significant simultaneity problem (see also later discussion in relation to general issue of endogeneity and the appli-

13 Summary statistics of all variables used is presented in Table 1. An overview of how the variables were constructed is provided in the Appendix.

14 See Dobson and Goodard (1992) for the argument as to why this is the best way to take account of capacity, in their case the capacity of football grounds in England.

15 Its construction was hugely labour intensive as data for each individual theatre, for each year, had to be inputted manually (see also Appendix).

cation of the empirical model). A different issue is that attendance is constrained by effective capacity and that as such the estimating model used needs to take account of this. In practice this is not an issue, as in only a tiny proportion of cases is there near full capacity utilization throughout the year, with the vast majority of theatres having capacity rates of less than 70 per cent. Besides, as discussed already, potential supply is substantially greater than actual supply, suggesting again that there is no serious issue with regard to capacity constraints.

4.2 Conventional Determinants

The first important factor influencing theatre attendance is the own admission price, even in the case where price is much lower than would apply were there no subsidies. To obtain the average price of a theatre ticket, TP_{jt}, total performance revenues for period t and theatre j are divided by the total number of tickets sold. This approach is commonly used in the performing arts literature (see Gapinski 1984, Toma and Meads 2007, Werck and Heyndels 2007) and in analyses of demand for tickets at sporting events (Baade and Tiehen 1990).[16] We expect the price elasticity for a service such as attending a theatre to be negative and most studies to date have confirmed this.

There is reason, though, to expect low own-price elasticities of demand for theatre. The first factor is that German theatres do not operate in a fully competitive environment usually, either because there are no other theatres in the immediate area or because the service is so specific that there is never a really close substitute. The second explanation for an expected low inelastic demand may be the fact the theatres looked at in this paper are non-profit and as such they would usually set low admission prices. If the ticket price is very low in comparison to that for other services, there may be no incentive for the consumer to decrease attendance when the ticket price increases by a small amount. A related factor is that tickets for the whole season, as with football matches, can be and are bought in advance, reducing further the effect of price on attendance at any particular show. The third reason may be the importance of output characteristics. Consumers attend an artistic performance for aesthetic and artistic reasons and the ticket price itself may not outweigh other important factors which visitors take into account.

The size of the theatre market, defined by its relevant population, P_{jt}, is the second conventional determinant to consider. To measure the relevant market for each theatre, the spatial weight matrix approach applied by Werck and Heyndels (2007) is used. It is defined as M_j for theatre j with $(m_{ik})_j$ elements grouping the relevant

[16] Separate information on theatre tickets was available in *Theaterstatistik*, but only in terms of highest and lowest prices and not in terms of an average. The fact that Y is being posited as a function of X/Y does not imply necessarily any automatic statistical relationship. The price may, however, be measured with an error which should be tested in the empirical model; this will be discussed in Sections 5 and 6.

regions into the relevant theatre market. Zieba (2009) applied the same approach to measure German theatre markets using the data on German districts and these data are applied here. Thus, the market of each non-touring German theatre consists of the district in which the theatre is located, its neighbouring districts and the border-sharing districts of their neighbours. For touring German theatres the market consists of all districts in the country.[17]

One would also expect theatre attendance to increase with increasing per capita disposable incomes. In order to obtain the income per capita variable, IN_{jt}, total market income is divided by total market population, P_{jt}.[18] We would expect the income elasticity of demand to exceed one. However, the empirical evidence with regard to the effect of income on theatre attendance is mixed. This may be due to the fact that to consume the performing arts a person must personally participate in an artistic event and this requires a sizeable amount of his / her leisure time. Thus, the conventional income effect could be the net effect of two factors, a pure income effect and a leisure-price substitution effect (see Withers 1980, Ekelund and Ritenour 1999 and Zieba 2009).

As with any good or service, the existence and price of substitutes and / or complements will also affect demand for theatre. How the size of the relevant population will translate into attendance at a particular theatre will depend first and foremost on the number of other theatres, private and public, in the district and also on other competing attractions in the area. To control partly for this, we include in our model the number of other public theatres, N_{jt} which are relevant for theatre j in period t.[19] As will be seen, however, this variable shows no variation for many non-touring theatres as they are mostly located in the cities where there are no other public theatres. Furthermore, it was impossible to measure the effects of all other substitutes / complements in any sensible way as what other private theatres and other attractions are in competition with the theatre in question is impossible to tell. Even if this were known, how could a weighted index of competing attractions be constructed, as the weights are not known. Besides, it would not only be the existence of this competition that matters but also its price and for this the price of all competing attractions would have to be known and weighted accordingly. Information to construct such a variable does not exist and using a wholly inaccurate proxy could provide spurious and misleading "scientific" results. Besides, the most important substitution effect could relate to the price of leisure (see above), where-

17 In addition, the rule is applied that the relevant market for each theatre depends on the geographical distance, defined as a circle with a radius of 45 – 50 km from the theatrical venue. For the formulation of the spatial weight matrix see Zieba (2009).

18 For the earlier periods there were no detailed income data at the districts' level. The missing regional data for the income variable were approximated using regional income shares.

19 For non-touring theatres, it is the number of public theatres located in a city of theatre j in period t whereas for touring theatres this is the number of all theatres in Germany (see also Appendix).

by as a result consumers switch not to other time-intensive substitutes but to other much less time-intensive substitutes.

It could perhaps be argued that there are no real substitutes for an evening at a theatre, as the participation of a consumer in a play is a "unique" individual experience. As such, it could be assumed that the high level of product diversification in the performing arts means that the cross-price elasticities between "different" cultural experiences can in fact be close to zero.

Nonetheless, theatre attendance in Germany has declined steadily over time (see Section 6.1), probably due to major substitution effects away from theatre. To capture this, time dummy variables are included as independent variables. The model therefore is picking up the impact of the key variables of interest on theatre attendance, taking into account the general factors over time affecting *overall* attendance at German theatres.

Furthermore, in order to eliminate the problem of omitted variables bias, the fixed-effects (within) estimator is applied to pick up the individual unobservable characteristics of particular theatres that do not change over time and are not captured in the other variables included. Such characteristics might be the level of competition faced by the theatre, something that as stated above is very difficult to measure in any other meaningful way. The inclusion of fixed-effect dummies is standard practice using panel data, but very often much of the explanation for the variation in the dependent variable is attributed to these undefined variables and not to the variables of interest. This as shall be seen later is not the case in this study.

4.3 Output Characteristics

Following Lancaster (1966), it can be assumed that consumers derive utility from certain characteristics of a good or service. In this context, Werck and Heyndels (2007) and Werck et al. (2008) discussed the output characteristics which might influence utility derived from a theatre performance. If a person finds attending a theatre to be a very enjoyable experience it is because of some output characteristics of that theatre and the work it produces.

Many different things affect the enjoyment of a theatre performance, in contrast to the situation applying to most other consumer goods and services. There are factors such as the technical ability of artists, the standard of costumes and stage design, the level of ancillary services in a theatre and the theatre building itself. Other non-physical output characteristics are the "character-acting ability" of the artists, repertoire classification, the reputation of an ensemble, the reaction, and / or composition of the audience or the general atmosphere of a theatre.

The problem with including output characteristics as determinants of theatre attendance is the issue of objective measurement. For physical products it is easier to find a number of properties such as the size, shape, colour, smell, chemical composition or level of technical sophistication. In relation to a theatre performance however there are so many different factors, many of them subjective and / or dependent on the particular performance on the night in question. The approaches taken in previous empirical studies differ greatly, in terms of variables used and level of sophistication. In this article a number of explicit and measurable output characteristics are posited which could impact, a priori, on theatre attendance and these are now outlined.

All variables used to "capture" output characteristics were derived from data available in successive issues of *Theaterstatistik*. The first three output characteristics used relate to quality and as such can be treated together. The first index used, REP_{jt}, attempts to capture the reputation of theatre j in theatre season t. It uses guest attendance of the theatre ensembles at other locations and it is measured by the proportion of paid attendance at guest performances in total paid attendance for all productions of the theatre in question. Guest performances can be interpreted as a form of promotion and recognition and should impact positively on future attendance at own location.[20] A second possible quality variable, discussed in Globerman and Book (1974) but in a different context, is labelled ARW_{jt}, and is constructed by dividing the personnel artistic expenses (wages), relevant for the particular theatre j in season t, by the number of all artists employed. The higher the index the greater is the average pay costs and hence one would expect the quality of the artists. A similar approach is used to define the technical level of stage design and costumes, DEC_{jt}. This quality variable is calculated by dividing the expenses for "décor and costumes" incurred for theatre j in season t by the number of all artists employed.

The other three output characteristics are not necessarily related to quality in any way but could impact on demand. The first of these, $INNO_{jt}$, is an index measuring innovation or conventionality for theatre j in theatre season t. While O'Hagan and Neligan (2005) constructed a quite sophisticated conventionality index for one year, it was not practical to do so here for 40 years for Germany. It was calculated for the purposes of this study as the ratio of new productions to all productions during one theatre season (see also Werck and Heyndels 2007).[21] Data to construct this were available only from 1990 / 1991. There is no reason to expect any particular sign for the coefficient of this variable as whether or not a theatre is innovative, as measured above, will impact differently on different consumers.

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20 Some theatres, by their nature, do most if not all of their performances on tour and as such this ratio for them would be very high and not in any way necessarily related to quality. As such, this is a drawback of the measure used.

21 An alternative way of measuring this was proposed by Krebs and Pommerehne (1995) and it is calculated by dividing the number of total performances by the number of new productions but it is not clear what this variable is measuring. Globerman and Book (1974) in order to account for quality in their cost functions used a "diversity index" calculated as the "number of main performances minus the average length of run of all productions, divided by main performances." The choice of this variable though was not explained.

The next output characteristic variable, $CAST_{jt}$, measures the scale of production (in terms of the cast size or more accurately total artistic staff complement for a season) for theatre j in season t (Werck and Heyndels, 2007). The number of artists is composed of those in drama (also musical theatre), ballet and opera (also operetta) as well as choir members and guest artists (playing in a theatre on a short-term contract basis) and the orchestra members employed in the theatre's own orchestra. Again there is no a priori reasoning with regard to the expected sign but one might expect, everything else being equal, that audiences would prefer larger staff complements, in terms for example of spectacle and variety.[22]

The final output characteristic variable, DIF_{jt} is the sum of dummy variables indicating product differentiation with regard to different genre of performances played in theatre j during season t. It is equal to $\sum_{k}^{K} D_{jkt}$ where D_{jkt} is an indicator variable equal to 1 if theatre j produced in season t a performance of specific art form (if the number of performances played for this specific art form was positive) and 0 otherwise. As mentioned, German theatres produce different arts forms. Accordingly, seven dummies are constructed: D_1 (opera), D_2 (ballet), D_3 (operetta), D_4 (musical), D_5 (drama), D_6 (children's and youth theatre), D_7 (symphony concert). Thus, the highest possible value for the index is 7 and the lowest is 1, representing the highest and the lowest degree of product differentiation, respectively. One might expect this to impact on demand, but how is difficult to predict. Some may perceive specialisation in this case to reflect quality whereas others may see having access "within house" to other art forms as indicating higher quality and variety, in terms of spill-over effects.

5. Empirical Strategy

5.1 Model Used

The availability of panel data permits greater flexibility in the specification of the econometric model. As already indicated in the previous section, to estimate the demand function unobserved heterogeneity across theatres is controlled for using theatre fixed effects. Time-specific effects (which change over time but are common to all theatres) may also be important. Taking logs of the demand function and including fixed-firm and time effects and a statistical noise term, the full empirical model is given in equation (1):

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22 Artistic staff complement size may also have an indirect effect on attendance as the larger the staff complement size the larger one would expect the size of the theatre, which in itself should explain a higher attendance. Besides, even allowing for theatre size, large-scale productions are more expensive and ticket price may be increased which will in turn impact on attendance.

$$\ln A_{jt} = c_j + d_t + \alpha_1 \ln TP_{jt} + \alpha_2 \ln IN_{jt} + \alpha_3 \ln C_{jt} + \alpha_4 \ln P_{jt} + \alpha_5 \ln N_{jt} + \sum_{k}^{N} \beta_k Q_{jkt} + u_{jt} \tag{1}$$

where α_k and β_k are coefficients of the determinants of theatre attendance to be estimated, c_j are the theatre specific fixed effects, d_t are the time indicators and u_{jt} is the statistical noise term with zero mean and constant variance.[23] The dependent variable in the model, A_{jt} is total paid theatre attendance for theatre j and in time period t, TP_{jt} is theatre own admission price, IN_{jt} is disposable income per capita; C_{jt} is total capacity of theatre, P_{jt} is theatre market size, and N_{jt} is number of theatres in the market of theatre j and time period t. Besides the conventional determinants, the key variable of interest is a vector of the objective output characteristics variables which is given by $\sum_{k}^{N} \beta_k Q_{jkt}$ where six output characteristics ($N = 6$) are considered. REP_{jt} is the share of guest attendance in total attendance, ARW_{jt} denotes artistic wages, DEC_{jt} denotes average expenses for décor and costumes per artist. The other three output characteristics are the innovation index, $INNO_{jt}$, cast size, $CAST_{jt}$ and the differentiation index, DIF_{jt}.[24]

In line with the earlier discussion, it is assumed that ticket price, TP_{jt}, will have a negative effect on theatre attendance, A_{jt}, while income, IN_{jt} and capacity C_{jt} should have a positive effect. One would expect the signs of the first three output-characteristic variables, REP_{jt}, ARW_{jt}, DEC_{jt}, all to be positive, assuming each is in some way an indicator of quality of production. It is difficult though to predict what the parameter estimates of the other three output characteristic variables might be. A more innovative theatre might appeal to some but not others, especially if new productions are at the expense of plays with wider appeal. The same is true of the product differentiation index but one might expect the coefficient of the artistic staff complement size variable to be positive.

It should be noted that the fixed-effects estimator provides consistent estimates of the coefficients of the time-varying regressors under a limited form of endogeneity. This means that the regressors in equation (1) may be correlated with the fixed effects, c_j, but not with the error term, u_{jt}. Therefore, we now consider a richer type of endogeneity, with the independent variables which may be correlated with u_{jt}.

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23 We eliminate the fixed effects, c_j, in equation (1) by subtraction of the corresponding model for individual means leading to the within-model or mean-difference model. Thus, all variables are calculated as deviations from the individual means over time (e.g., $X_{jt} - \overline{X}_j$). The within estimator is the OLS estimator of this model.

24 The log transformations were not applied to the following three output characteristics variables: REP_{jt}, $INNO_{jt}$ and DIF_{jt}. The output characteristics describing theatre reputation, REP_{jt}, and innovation, $INNO_{jt}$ are ratios measured in per cent, taking values between 0 and 1. The differentiation index, DIF_{jt}, is a discrete variable taking values from 1 to 7.

5.2 Endogeneity Issue

The fact that effective capacity, C_{jt}, may be influenced by attendance, at least in previous years, and hence not be an exogenous variable, has been discussed already in Section 4.1. Another concern relates to price. The endogeneity of theatre ticket price, TP_{jt}, may come from the classical issue in demand-model estimation where theatre attendance and prices are simultaneously determined by demand and supply. However, many previous studies on demand for the performing arts applied a single-equation model in which they explicitly assumed that ticket price is exogenous given the recursive nature of theatrical productions (Moore 1966, Withers 1980, Gapinski 1986, Ekelund and Ritenour 1999).[25] This assumption may also hold for German public theatre. First, the supply of German public theatre does not respond to demand during the yearly theatre season, as the repertoire and the ticket price, as seen earlier, are specified in advance.[26] Second, according to Krebs and Pommerehne (1995)[27] an artistic director in a public German theatre has no influence on the theatre ticket price and, hence, theatres are not free to change prices in a flexible way. Public theatres in Germany are subsidised by the state in the form of covered deficits; the share of total operating revenues from ticket sales accounts for on average only about 30 per cent of total revenues.[28]

Nevertheless, another source of potential simultaneity bias in equation (1) may result from the inclusion of output characteristics variables as some of them such as artistic wages, ARW_{jt}, outlay on décor and costumes per artist, DEC_{jt}, and cast size, $CAST_{jt}$, may be interpreted as supply factors in a theatre, whether as costs or inputs of production. Thus, these factors may be also directly influenced by theatre managers (Krebs and Pommerehne 1995) and not be exogenous as they may be altered to respond to attendance. The observed output-characteristics variables could be also correlated with the unobserved variables such as time-varying managerial capability across theatres or different productivity shocks which change over time.

Finally, it could be argued that income per capita may be influenced by the cultural infrastructure of a region, as the latter may act as a magnet for inward invest-

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25 In contrast, Lange and Luksetich (1995) and Werck et al. (2008) apply a simultaneous modeling technique to the same empirical question. However, these studies do not provide comparable results from a single estimation technique that would have shed some helpful light on the nature of the simultaneity bias in a single demand equation (see also Toma and Meads 2007).

26 In the case of German public theatre one or two more performances are added to the theatrical schedule in exceptional circumstances because of the higher demand than expected. However, price is not readjusted.

27 Krebs and Pommerehne (1995) discussed the politico-economic interactions of German public theatres and also estimated the demand function using aggregate time series data for all German public theatres (see also Table 4).

28 Excluding income from subscription and visitor organisations tickets, which make up 27 per cent of all operating revenues, the share of revenues from daily tickets in total revenues reduces to only 22 per cent.

ment. This would imply that income per capita is also not an exogenous variable in the model. On the other hand, the dependent variable here is attendance in a single theatre in a region which is very different to a measure of the cultural infrastructure of a region. It would be difficult to argue that such attendance figures of themselves influence inward investment and hence regional incomes.

On the whole, it is difficult to confirm a priori if ticket price and other explanatory variables in equation (1) are influenced by demand.[29] However, if the assumption of strict exogeneity on the explanatory variables is violated our fixed-effects estimator would be potentially inconsistent. For these reasons it seems appropriate to examine the endogeneity issue empirically.

5.3 Dynamic Panel Difference GMM Estimation

In order to control for unobserved time-varying endogeneity within the FE-effects framework we need to apply strictly exogenous instrumental variables. However, in practice, identifying and justifying such instruments is very difficult and sometimes impossible.[30] Furthermore, our data set does not supply us with potential valid instruments for the variables in question.[31]

Drawing on the panel nature of the data, however, we can derive a set of valid instruments by using the lagged (historical) values of our explanatory variables. Whereas the fixed-effects estimator rules out lagged values of endogenous regressors as valid instruments,[32] the first-difference estimator allows for it under certain conditions as discussed below. Therefore, we apply the Arellano-Bond (1991) one-step difference GMM (General Methods of Moments) estimator first proposed by Holtz-Eakin, Newey, and Rosen (1988). It has an advantage over the more straightforward fixed-effects estimator as it both eliminates the theatre-specific effects and

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29 Another bias in the fixed effects model could arise when the explanatory variables in equation (1) are measured with an error, thus $X_i^* = X_i + v_i$, and hence observations are available (where v_i is a random variable "measurement error") instead of genuine measure X_i. Such measurement errors could possibly be included in the ticket price, TP_{jt} or disposable income variable, IN_{jt}.

30 One potential solution would be using a system of equations which would determine both the demand and the supply of theatre. In this case, in one equation the attendance would be allowed to depend on the demand factors as specified in equation (1) while in other equations the price and other output characteristics would depend on theatre attendance and other control variables. In order to determine the strictly exogenous instruments they must be, for example, at least one variable in the price equation that is not important in the demand equation.

31 Applying only the instruments which are weakly correlated with the endogenous variables are likely to lead to the biased fixed-effects IV estimators in the way the OLS estimators are.

32 For consistency, the fixed effects estimator requires that the mean-deviated form of the explanatory variable (e.g., $X_{jt} - \overline{X}_j$) is uncorrelated with the mean-deviated disturbance $(u_{jt} - \overline{u}_j)$. $\overline{X}_j$ involves all past, current and future values of X_{jt}, so that any lagged endogenous regressors will be correlated with the error term u_{jt}.

accommodates the use of endogenous regressors. The GMM estimator eliminates the individual effects, c_j, by first-differencing equation (1).[33] The specification also allows us to include the first-differenced lagged dependent variable ($\Delta \ln A_{j,t-1} = \ln A_{j,t-1} - \ln A_{j,t-2}$) on the right-hand side of equation (1). This provides a useful dynamic extension of our model since theatre demand in the previous year is likely to influence demand in the current year.

The correlation between $\ln A_{j,t-1}$ and $u_{j,t-1}$ implies that OLS estimation will be inconsistent. However, we can derive a set of instruments which are both correlated with $\Delta \ln A_{j,t-1}$ and orthogonal to $u_{j,t-1}$. These instruments are all lags of $\ln A_{jt}$ dated $T-2$ and longer. Similarly we can apply the same procedure to any other endogenous explanatory variables in equation (1) giving rise to an instrument matrix. Thus, all endogenous regressors (transformed in first differences) are instrumented by their lags in levels. The first-differenced lagged dependent variable is also instrumented with its past levels.[34] Furthermore, if we assume that some of the regressors in equation (1) are strictly exogenous, they can be used as instruments for themselves.

The consistency of the system GMM estimator depends on the validity of the instruments—they need to show some form of autocorrelation over time and the error term u_{jt} should not be serially correlated. To address these concerns we use two specifications tests suggested by Arellano and Bond (1991) which are the test of serial correlation (the first differenced residuals should exhibit negative first-order serial correlation but no second-order serial correlation) and a Sargan-Hansen test of overidentifying restrictions.[35] As it will be shown in Section 6.2, failure to reject the null hypothesis of both specification tests gives support to our dynamic-panel model.

6. Results

6.1 Broad Trends

It might be instructive to provide first a summary of some of the key descriptive statistics used to estimate the model. There are around 20 million visits annually to theatre in Germany but the trend in attendance has been steadily declining

33 We transform all variables in equation (1) as follows: $\Delta \ln A_{jt} = \ln A_{jt} - \ln A_{j,t-1}$, $\Delta X'_{jt} = X'_{jt} - X'_{j,t-1}$, $\Delta d_t = d_t - d_{t-1}$, $\Delta u_{jt} = u_{jt} - u_{j,t-1}$, and X'_{jt} correspond to all explanatory variables presented in equation (1).

34 After first-differencing the data, $\ln A_{j,t-2}$ or $X'_{j,t-2}$ are uncorrelated with the Δu_{jt} and they can be used as instruments for $\Delta \ln A_{j,t-1}$ or $\Delta X'_{jt}$, respectively. This makes the endogenous variables predetermined and not correlated with the error term u_{jt}.

35 The GMM estimator uses multiple lags as instruments which means that our system is overidentified which needs to be tested. In the case of standard errors adjusted for heteroskedasticity and within firm correlation, the Sargan test is inconsistent and a Hansen J-statistic is reported which has an asymptotic χ^2 distribution under the null hypothesis that the instruments are valid.

(see Figure 1). For example, total attendance in West Germany decreased from 20.3 million in 1965 / 1966 to 15.8 million in 1989 / 1990 and in Germany as a whole total attendance dropped from 20.3 million in 1990 / 1991 to 18.2 million in 2004 / 2005.

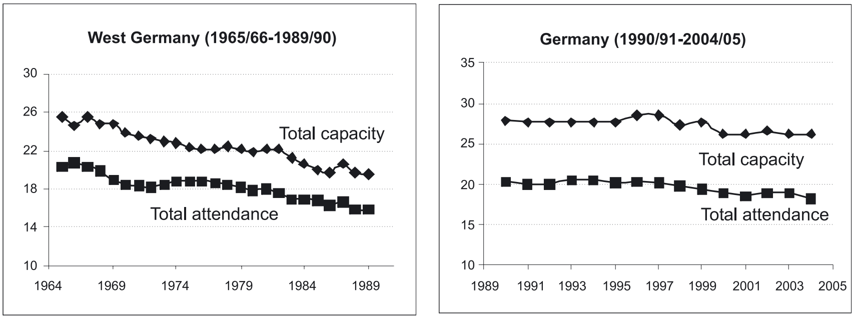

Figure 1: Total Attendance and Capacity

The total capacity of West German theatre (seats on offer for an entire season) also declined over the period (Figure 1),[36] from 25.5 million in 1965 / 1966 to 19.6 million in 1989 / 1990. The total capacity for Germany as a whole also decreased from 27.9 million in 1990 / 1991 to 26.3 million in 2004 / 2005. This was totally due to a reduction in the number of performances in a year, as the total number of physical seats increased if anything. This reduction was primarily in the larger theatres, as the average number of performances per theatre did not decline. The average capacity utilization (paid attendance as a percentage of effective supply, not possible supply) varied between 61 and 73 per cent over the period.[37] The capacity utilization for both unpaid and paid attendance is higher, as expected, and it ranges from 69 to 81 per cent.

Over the two periods, real ticket price increased steadily, for the former West Germany from € 9 in 1965 / 1966 to € 13.4 in 1989 / 1990 (Figure 2). For all of Germany, it increased from € 12 in 1990 / 1991 to € 15.75 in 2004 / 2005. These are very sizeable increases in price adjusted for inflation and one would expect some of the decrease in attendance. On the other hand, real income per capita in

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36 Total capacity does not include the total capacity for guest performances of theatres. Thus, the total theatre capacity was calculated by multiplying the number of seats at own venues by the number of performances staged also at own venues. The capacity utilization index is calculated as the ratio of own attendance (at own house) divided by the total capacity (at own house).

37 We examined capacity utilisation in a sample of theatres in Aachen, Berlin, Bielefield, Bochum and Hamburg and found it to vary in most years for each theatre from around 70 to 80 per cent, dropping in some years to 60 per cent and rising to near 90 per cent in a few years.

West Germany more than doubled between 1965 / 1966 and 1989 / 1990 (Figure 2), with a further significant increase for all of Germany between 1990 / 1991 and 2004 / 2005. These trends, everything else being equal, should have led to an increase in paid attendance.

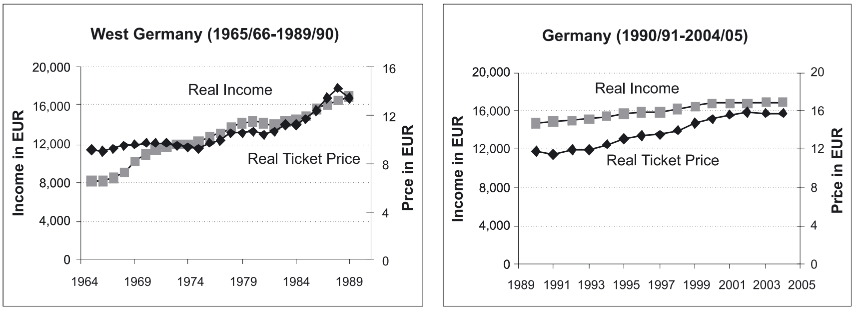

Figure 2: Real Income and Ticket Price

The number of artists employed in German theatre increased steadily from around 11.1 thousand in 1965 / 1966 to 15.6 thousand in 1989 / 1990 (Figure 3). There was also an increase in average number of employees per theatre, as the total number of theatres decreased over the period.[38] There was an increase in average outlay per employee in the theatre sector over the time periods in question but the increase was less than the increase in real income per capita. On the other hand the increase in outlays on decor and costumes per person employed increased substantially and much in line with average per capita incomes.

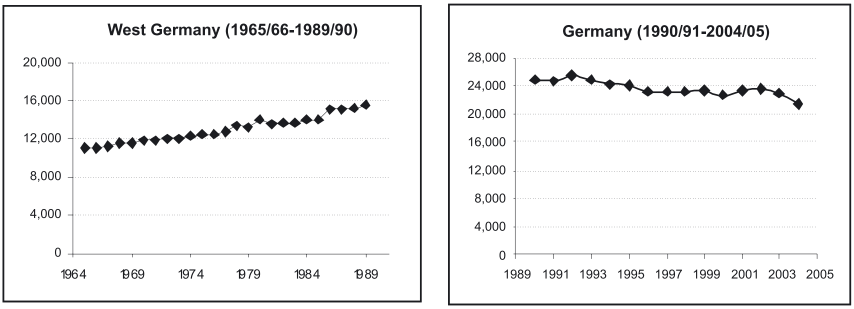

Figure 3: Total Number of Artists Employed

38 The number of artists includes: artistic management staff, singers, dancers, actors, musicians, orchestra and choir members and guest artists. Guest artists are given a weight of 0.5 in order to account for the fact that they are employed only on a part-time basis.

Table 1

Summary Statistics

Variable	(1) West Germany 1965 / 1966 – 1989 / 1990		(2) Germany 1990 / 1991 – 2004 / 2005	
	Mean	St. Dev.	Mean	St. Dev.
A_{jt}, total attendance	219,442	138,949	132,895	96,829
TP_{jt}, ticket price	10.55	5.55	13.73	8.69
IN_{jt}, income per capita	12,792	3,611	15,930	3,890
P_{jt}, market size – population ('000)	14,354	22,301	16,022	28,658
for city theatres	3,909	2,569	3,589	2,338
for touring theatres	61,423	754	81,670	1,012
N_{jt}, number of theatres	16	31	26	53
in the city	1.5	1.1	2.14	2.49
in the whole country	83	1.7	148	4.32
C_{jt}, capacity	271,091	188,380	184,700	136,591
REP_{jt}, guest index	0.19	0.24	0.15	0.18
ARW_{jt}, artistic wages	37,530	14,968	40,975	18,041
DEC_{jt}, décor & costumes	2,635	2,639	3,588	4,268
$CAST_{jt}$, cast size	157	114	160	125
DIF_{jt}, differentiation index	4.4	2.3	4.5	2.1
$INNO_{jt}$, innovation index	–	–	0.65	0.93

The variables: TP_{jt}, IN_{jt}, ARW_{jt} and DEC_{jt} are presented in EUR for the year 2000.

Table 1 also provides the basic descriptive statistics for the full sample of theatres. There is huge variation between theatres in Germany. For example, average annual attendance per theatre in West Germany (1965 – 1989) was around 220 thousand, but the standard deviation was 139 thousand. Reflecting this, effective average yearly capacity per theatre was around 271 thousand but with a standard deviation of 188 thousand. This of course is reflected in total numbers employed, with an average of around 157 per theatre, but again with a large standard deviation, in this case of 114. The same huge variation in both variables can be found for all Germany from 1990 to 2004. There was also a huge variation for both West Germany and all Germany in outlays on wages and decor and costumes, per person employed. Less important, perhaps, given the somewhat arbitrary way of defining the potential market for each theatre, the population of the "relevant" region also varied very considerably. More important there is significant variation in income per capita across the relevant regions. The variation in the number of theatres is rather small as on average there were about 1.5 or 2 theatres located in the same city, with a standard deviation of 1.1 or 2.5. In fact, this measure must be interpreted with caution as for 54 per cent of theatres (non-touring theatres) N_{jt} equals one so that for these theatres the within variation is zero. Thus, only for the rest of theatres (both non-touring and regional theatres) is there some variation in the data.

6.2 Model Estimates

The estimates of determinants of theatre attendance obtained using the fixed-effects estimator are presented in Table 2 and the results obtained using the dynamic difference GMM estimator are reported in Table 3. In both tables, we split the sample into two groups: 93 West German theatres which operated between 1965 / 1966 and 1989 / 1990 and 170 German (both West and East) theatres which operated between 1990 / 1991 and 2004 / 2005. The log-linear model was chosen since a substantially better statistical fit was obtained through the use of the logarithmic transformation of most of the variables as compared to a linear function.[39] The logarithmic transformation has also the advantage that the estimates of determinants of theatre attendance can be interpreted as direct partial elasticities.[40]

Table 2 presents the results obtained using the fixed-effects estimator given by equation (1). In each case the Hausman test validates the use of the within estimator while an F-test indicates that a pooled model estimated using OLS would produce inconsistent estimates. The overall explanatory power of the included variables is good. The estimates of price elasticity, $\ln TP_{jt}$ are negative, as expected, highly significant and show almost no variation across the two different time periods. The estimates of income per capita, $\ln IN_{jt}$ and total capacity, $\ln C_{jt}$ are positive, as expected, highly significant and also very similar across different time periods. The coefficient of the variable describing market size of theatre, $\ln P_{jt}$ is positive and significant only for the West German theatres in column (1). Finally, the number of theatres, $\ln N_{jt}$, has a significant and positive effect on attendance for the first period but a significant and negative effect for all Germany in column (2).

The results with regard to the output characteristic variables are quite striking. In relation to the first three output characteristics (REP_{jt}, $\ln ARW_{jt}$, $\ln DEC_{jt}$), which are good proxies for quality, all of the coefficients are positive and highly significant, except the coefficient for outlay on décor and costumes per artist, $\ln DEC_{jt}$ which has the excepted sign but it is not significant. In all cases the expectation was that the coefficients would be positive and this is what has emerged.

The estimate for the coefficient of the innovation variable, $INNO_{jt}$, which could be applied only to the second period, is significant but negative. The coefficient of the staff complement size variable, $\ln CAST_{jt}$, is positive, implying that the greater the staff complement the higher the attendance even taking into account theatre capacity. Finally, the estimated coefficient for the differentiation variable, DIF_{jt}, is

39 The linear model was also tested against the log-linear model using the MacKinnon, White and Davidson test. These results suggest that the log-linear model encompasses the linear model.

40 As already indicated in section 5.1, the log transformations were not applied to the three output characteristics variables: REP_{jt}, $INNO_{jt}$ and DIF_{jt} for which the estimated coefficients are interpreted as semi-elasticities. In order to obtain the direct elasticities, we multiply the estimated coefficients by their sample means from Table 1. The derived elasticities are reported in the footnotes to Tables 2 and 3.

positive and significant in the first period. On the whole, it should be noted that even when the theatre-fixed effects and time-fixed effects are netted out in Table 2, the explanatory power of the remaining variables is high.

Table 2

Estimates of Determinants of Attendance—Fixed Effects Model

Dependent variable: $\ln A_{jt}$, total attendance	(1) West Germany 1965 / 1966 – 1989 / 1990	(2) Germany 1990 / 1991 – 2004 / 2005
Constant	–16.46** (5.16)	0.383 (4.510)
$\ln TP_{jt}$, ticket price	–0.359*** (0.069)	–0.340*** (0.050)
$\ln IN_{jt}$, income per capita	0.620*** (0.258)	0.648*** (0.191)
$\ln P_{jt}$, market size	1.222*** (0.343)	–0.100 (0.372)
$\ln N_{jt}$, number of theatres	0.150** (0.079)	–0.332** (0.139)
$\ln C_{jt}$, capacity	0.500*** (0.112)	0.411*** (0.076)
REP_{jt}, guest index	1.168*** (0.159)	0.920*** (0.114)
$\ln ARW_{jt}$, artistic wages	0.333*** (0.081)	0.116*** (0.051)
$\ln DEC_{jt}$, décor & costumes	0.071 (0.044)	0.015 (0.017)
$\ln CAST_{jt}$, cast size	0.427*** (0.121)	0.126** (0.065)
DIF_{jt}, differentiation index	0.034*** (0.009)	0.011 (0.011)
$INNO_{jt}$, innovation index	–	–0.007** (0.003)
Observations	2045	2209
Number of theatres	93	170
Adj. within R^2	0.58	0.47
F-statistics	26.95***	24.03***
Hausman Test (Chi-Squared)	189.7***	179.0***

1. Time dummies are included but not displayed.

2. Cluster-robust standard errors in parentheses. *** indicate significance at the 1 per cent level. ** and * indicate significance at the 5 and 10 per cent level respectively.

3. The coefficients of the variables: REP_{jt}, DIF_{jt} and $INNO_{jt}$ are semi-elasticities. The elasticities are calculated using the sample means from Table (1) and these are: 0.22 and 0.14 for REP_{jt}, 0.15 and 0.05 for DIF_{jt}, for the first and second column respectively, and –0.005 for $INNO_{jt}$.

Table 3

Estimates of Determinants of Attendance—Difference GMM Model

Dependent variable: A_{jt}, total attendance	(1) West Germany 1965 / 1966 – 1989 / 1990	(2) Germany 1990 / 1991 – 2004 / 2005
$\ln A_{jt-1}$, lagged attendance	0.216*** 0.071	0.152*** 0.052
$\ln TP_{jt}$, ticket price	–0.312** (0.127)	–0.380*** (0.075)
$\ln IN_{jt}$, income per capita	0.485 (0.779)	0.562** (0.217)
$\ln C_{jt}$, capacity	0.429*** (0.087)	0.280*** (0.059)
REP_{jt}, guest index	0.966*** (0.160)	0.713** (0.101)
$\ln ARW_{jt}$, artistic wages	0.491*** (0.151)	0.262** (0.108)
$\ln DEC_{jt}$, décor & costumes	0.020 (0.020)	0.008 (0.011)
$\ln CAST_{jt}$, cast size	0.607*** (0.149)	0.246** (0.101)
DIF_{jt}, differentiation index	0.002 (0.004)	0.014** (0.006)
$INNO_{jt}$, innovation index	–	–0.001 (0.021)
Observations	1852	2024
Number of theatres	92	166
Number of instruments	79	132
F-statistics	38.56***	20.01***
AR(1) test (*p*-value)	0.00	0.00
AR(2) test (*p*-value)	0.12	0.14
Hansen *J*-test for overid. restrictions (*p*-value)	0.22	0.27
Diff-in-Hansen tests of exogeneity of GMM instrument subsets (p-values)		
GMM instrument for $\ln A_{j,t-1}$	0.31	0.16
GMM instrument for $\ln TP_{jt}$	0.43	0.98
GMM instrument for $\ln IN_{jt}$	0.73	0.10
GMM instrument for $\ln ARW_{jt}$	0.12	0.86
GMM instrument for $INNO_{jt}$	–	0.67

1. Time dummies are included but not displayed.

2. Cluster-robust standard errors in parentheses. *** indicate significance at the 1 per cent level.** and * indicate significance at the 5 and 10 per cent level respectively.

3. The coefficient of the variables: REP_{jt}, DIF_{jt} and $INNO_{jt}$ are semi-elasticities. The elasticities are calculated using the sample means from Table (1) and these are: 0.18 and 0.11 for REP_{jt}, 0.01 and 0.06 for DIF_{jt}, for the first and second column respectively, and –0.0007 for $INNO_{jt}$.

The results of the dynamic model corrected for simultaneity bias are reported in Table 3. To construct a GMM instrument matrix, we first investigated the potential endogeneity of our explanatory variables by using Difference-in-Hansen tests. The choice of model was further based on the significance of the estimates, as well as the Arellano-Bond test for AR(1) and AR(2) in first differences, the Hansen tests of overidentifying restrictions and the Difference-in-Hansen tests of exogeneity of instruments subsets (see Table 3). In order to increase the power of the tests, we reduced the number of instruments of all endogenous variables to the three most recent lags for the first period in column (1) and to the six most recent lags for the second period in column (2) so that the number of instruments is not greater than the number of theatres in each case.[41] The most appropriate difference GMM model treats $\ln A_{j,t-1}$, $\ln TP_{jt}$, $\ln IN_{jt}$, $\ln ARW_{jt}$ and $INNO_{jt}$ as endogenous. Other remaining output characteristics are treated as exogenous. Market size, $\ln P_{jt}$ and the number of theatres, $\ln N_{jt}$ were not significant in any of the GMM model specifications we have tested, whether or not they were treated as endogenous. Therefore, they have been excluded from Table 3.[42]

The coefficients presented in Table 3 are very similar to the estimates obtained using the fixed-effects estimator. The coefficient of the ticket price, $\ln TP_{jt}$ is significant, negative and has the same magnitude as the price coefficient obtained in Table 2. This confirms that the potential bias in the price estimate is small which confirms our previous assumption that price may be treated as exogenous. Similar coefficients to those obtained using fixed-effects estimator can be found for total capacity, $\ln CAP_{jt}$ and disposable income, $\ln IN_{jt}$. The latter is positive but it is not significant in the first column of Table 3.[43] With regard to output characteristics variables, they also have the correct signs and similar significance levels to those in Table 2. However, the GMM application also demonstrates the importance of controlling for both dynamic endogeneity and unobservable heterogeneity. For example, while the guest index estimate, REP_{jt} is slightly lower, both artistic wages, $\ln ARW_{jt}$, and the cast size, $\ln CAST_{jt}$, have a greater impact on attendance when we control for the simultaneity bias. Additionally, in contrast to the results presented in Table 2, the coefficient of the innovation index is negative but not significant and

41 The model was estimated using the -xtabond2-command in Stata and the number of instruments was further limited using the -collapse-option. Further details on the relevant tests are available on request.

42 The tests indicated that for the first period 1965 / 1966 – 1989 / 1990 none of the regressors (apart from the lagged dependent variable) are in fact endogenous. However, we include the same set of endogenous variables in the first column as in the second column of Table 3 in order to check the consistency of the results. We also test different specifications including for example, $\ln CAST_{jt}$, $\ln DEC_{jt}$ and REP_{jt} as additional endogenous regressors. The results do not change but the Hansen-test statistics is close to 1 (due to a large number of GMM instruments) indicating a weak power of the test.

43 This could be also due to the loss of efficiency in the GMM model when the instrumented variable is in fact exogenous as it may be the income variable in our case. However, even when we treat income as exogenous, its coefficient is still not significant in column (1).

the estimate of the differentiation index is significant in column (2) but not significant in column (1). All of this would suggest that while price is exogenous, some of the output characteristics may be adjusted by theatres in response to demand. Nevertheless, despite these small discrepancies, the results confirm the overall importance of the impact of the output characteristics on theatre attendance.

7. Conclusion

Despite all of the difficulties in estimating the effects of different variables on theatre attendance, the results outlined above are reassuring. Ticket price, TP_{jt}, emerges as having a statistically significant effect, with the correct sign and with elasticity values of around 0.35. As may be seen in Table 4, these values are very similar to those obtained by Gapinski (1984) and Moore (1966), but higher than those for Werck and Heyndels (2007) and Withers (1980).[44] The values in all these studies though are in the same "ballpark" which is remarkable given the greatly different data sources and situations. Given the scale and reliability of German data, the evidence here would suggest that the price elasticity of demand for theatre may be lower than previously found, and below minus 0.4,[45] a finding confirmed by the only other study which used a large data set (Werck and Heyndels 2007). The earlier discussion outlined why low price elasticity might be expected.

As discussed earlier also, there are likely to have been significant substitution effects operating with regard to German public theatre over the periods examined, but the difficulty of identifying what those substitute activities are (e.g., sports, cinema, TV, leisure, other live performing arts) and even more problematic measuring the weighted price of these substitute activities makes it impossible to assess in any meaningful quantitative way these effects. The time dummies though did pick up these effects, on overall attendance at German theatre, and indicated that they were highly significant.

Estimates of the (disposable) income elasticity, IN_{jt}, are positive and highly significant and vary from around 0.5 to 0.6 depending on the time period chosen. As may be seen in Table 4, estimates of income elasticity vary widely across the different studies undertaken, ranging from 0.06 (Gapinski 1986) to 2.35 (Werck and Heyndels 2007).

All of this suggests that income elasticity estimates of demand for theatre are as yet highly unreliable, with perhaps the estimates for this study being the most

44 See Seaman (2006) for a review of the previous literature in relation to estimates for the effect of own price, income, price of substitutes and quality factors. Only the more reliable studies are referred to in this article though.

45 As mentioned already, these estimated values were extremely robust with regard to time period chosen.

Table 4: **Previous Main Estimates of Price and Income Elasticities of Demand for Performing Arts**

Author	Art Form	Country	Data Type	ELASTICITIES[a)] Admission Price	Price of Substitutes	Income
Moore (1966)	Broadway theatre shows	U.S.	Aggregate time series (1926 – 1963) and cross section for 1926	–0.63 to –0.33	–	0.34 to 0.42
Withers[b)] (1980)	All arts forms	U.S.	Aggregate time series 1929 – 1973	–1.19 to –0.62	0.62 to 1.35	0.64 to 1.55
Gapinski (1984)	Drama	UK (London)	Aggregate time series	–0.66	–	1.33
Gapinski (1986)	Separately for drama, opera, dance and classical concerts	UK	Panel data 13 companies, 1971 / 72 – 1982 / 83	–0.29 to –0.07	0.12 to 0.5	0.06 to 0.26
Krebs and Pommerehne (1995)	All arts forms	Germany	Aggregate time series 1961 / 62 – 1991 / 92	–0.16 (short run) –2.5 (long run)	–	–
Ekelund and Ritenour[b)] (1999)	Classical Concerts	U.S.	Aggregate time series 1973 – 1992	–[c)]	–[c)]	0.78
Werck and Heyndels (2007)	Drama	Belgium	Panel data, 59 companies over period 1980 – 2000	–0.16 to –0.14	–	1.72 to 2.35
Zieba (2009)	All arts forms	Germany	Panel data, 178 theatres over period 1965 / 66 – 2004 / 05	–0.27 to –0.43	0.05 to 0.06	0.60 to 1.22

[a)] All studies used theatre attendance as the dependent variable. "–" means that the elasticity is not significant / of wrong sign or is not estimated; [b)] Withers (1980) and Zieba (2009) estimated additionally the full income and the leisure price elasticity (see text); Ekelund and Ritenour (1999) included also the price of leisure in the demand equation and its coefficient was significant and of expected negative sign. [c)] The elasticities were not explicitly estimated in this study but the coefficients of the own admission price and the price of substitutes were significant and of expected sign.

reliable to date, given the huge data set available and the apparent stability in the estimates as different models were applied. If so, it would suggest that while attendance is sensitive to income, the elasticity is around 0.6. This income elasticity effect though is the net outcome of two effects, as discussed earlier. Withers (1980) and Zieba (2009) both find that the pure income elasticity is much higher than the net income effect, which is offset by a large leisure-price effect. However, it is the net effect in a sense which matters in terms of gauging the impact of rising disposable incomes on theatre attendance.

A particularly interesting aspect of the empirical findings of this study was the impact of the output-characteristic variables included in the regressions. What is of interest is the signs of these elasticities. With regard to the first quality-related output characteristic, the coefficient of "guest attendance," REP_{jt}, was positive, implying that an increase in attendance at guest performance as a proportion of total attendance would increase total attendance, something perhaps that one might expect. The estimated elasticities of the other two quality-related output characteristics which are average wages, ARW_{jt} and décor and costumes expenses per artist employed, DEC_{jt} are positive, and in the case of ARW_{jt} highly significant. There is though a cost to increasing expenditures in these areas which might be not justified simply in terms of increased attendance.

The estimate of elasticity for the fourth output characteristic, $INNO_{jt}$ (innovation index), was negative but significant only in Table 2. Again this might have been expected but it is also possible that more people might have been attracted to the theatre because of its reputation for producing new productions. The estimate of elasticity of the output characteristic variable, $CAST_{jt}$ (average artistic size) is positive and significant, which tallies with the findings of Werck and Heyndels (2007) and indicates that large-scale productions are preferred to small-scale productions, even after adjusting for the size of the theatre. The estimate of elasticity for the factor DIF_{jt} (product differentiation) is positive but significant only for the first period in Table 2 and the second period in Table 3. It suggests that theatres specializing in different performances (arts forms) can increase attendance much more than theatres specialising only in one art form. It may indicate that wide product range increases the attendance as visitors' expectations for different arts forms can be met. However, this estimate is very low, indicating a small impact on theatre attendance.

This study has established that the output-characteristic variables looked at, some more directly related to quality than others, do indeed impact on theatre attendance and that their importance is as great, if not more so, than the traditional economic variables examined. The findings also suggest that these output characteristics, rather than the price reductions, may offer a more effective way of attracting theatre visitors. These factors may be even more important due to the fact that the demand for theatre is price-inelastic. While all of these variables are significant in explaining trends, it is likely though that some of the explanatory factors (e.g., the range and price, including that of time, of other leisure activities) responsible for the decline in attendance in recent decades have to be found outside the confines of an econometric model. The estimates here though do indicate that output characteristics, price and income do matter also and that they can be measured in an explicit and concise way.

References

Abbé-Decarroux, F. (1992): "The Perception of the Quality and the Demand for Services. Empirical Application to the Performing Arts," Journal of Economic Behavior and Organization 23, 99–107.

Arrellano, M. / *Bond,* S. (1991): "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations," Review of Economic Studies 58 (1), 277–297.

Bade, R. / *Thielen,* L. (1990): "An Analysis of Major League Baseball Attendance, 1969–1987," Journal of Sport and Social Issues 14, 14–32.

Dobson, S. / *Goddard,* J. (1992): "The Demand for Standing and Seated Viewing Accommodation in the English Football League," Applied Economics 24, 1155–1163.

Ekelund, R. / *Ritenour,* S. (1999): "An Exploration of the Beckerian Theory of Time Costs: Symphony Concert Demand", American Journal of Economics and Sociology 58, 887–899.

Gapinski, J. (1984): "The Economics of Performing Shakespeare," American Economic Review 74 (3), 458–466.

– (1986): "The Lively Arts as Substitutes for the Lively Arts," American Economic Review 76 (2), 20–25.

Globerman, S. / *Book,* S. (1974): "Statistical Cost Functions for Performing Arts Organizations," Southern Economic Journal 40 (4), 668–671.

Hofmann, J. (1998): "The Theatre System of Germany," in Theatre Worlds in Motion. Structures, Politics and Developments in the Countries of Western Europe, edited by H. Maanen and S. Wilmer, Amsterdam-Atlanta, Rodopi, 223–257.

Holtz-Eakin, D. / *Newey,* W. / *Rosen,* H. (1988): "Estimating Vector Autoregressions with Panel Data," Econometrica 56, 1371–1396.

Krebs, S. (1996): Öffentliche Theater in Deutschland: Eine Empirisch-Ökonomische Analyse, Berlin, Verlag für Wissenschaft and Forschung GmbH.

Krebs, S. / *Pommerehne,* W. (1995): "Politico-Economic Interactions of German Public Performing Arts Institutions," Journal of Cultural Economics 19, 17–32.

Lancaster, K. (1966): "A New Approach to Consumer Theory," Journal of Political Economy 74, 132–157.

Lange, M. / *Luksetich,* W. (1995): "A Simultaneous Model of Nonprofit Symphony Orchestra Behavior," Journal of Cultural Economics 19, 49–68.

Lévy-Garboua, L. / *Montmarquette,* C. (1996): "A Microeconometric Study of Theatre Demand," Journal of Cultural Economics 20, 25–50.

Moore, T. (1966): “The Demand for Broadway Theatre Tickets,” Review of Economics and Statistics 48 (1), 79 – 87.

Neligan, A. (2006): “Public Funding and Repertoire Conventionality in the German Public Theatre Sector: An Econometric Analysis,” Applied Economics 38, 1111 – 1121.

O’Hagan, J. (1998): The State and the Arts: An Analysis on Key Economic Policy Issues in Europe and the United States, Cheltenham, Edward Elgar Publishing Limited.

O’Hagan, J. / *Neligan,* A. (2005): “State Subsidies and Repertoire Conventionality in the Non-Profit English Theatre Sector: An Econometric Analysis,” Journal of Cultural Economics 29, 35 – 57.

Schulze, G. / *Rose,* A. (1998): “Public Orchestra Funding in Germany—An Empirical Investigation,” Journal of Cultural Economics 22, 227 – 247.

Seaman, B. (2006): “Empirical Studies of Demand for the Performing Arts,” in Handbook of the Economics of Art and Culture, edited by V. Ginsburgh and D. Throsby, Volume 1, Amsterdam, Elsevier, 416 – 472.

Throsby, D. (1983): “Perception of Quality in Demand for the Theatre,” in Economics of Cultural Decisions, edited by W. Hendon and J. Shanahan, Abt Book, Cambridge (MA) and reprinted in Journal of Cultural Economics (1990), 14 (1), 65 – 82.

Tobias, S. (2004): “Quality in the Performing Arts: Aggregating and Rationalizing Expert Opinion,” Journal of Cultural Economics 28, 109 – 124.

Toma, M. / *Meads,* H. (2007): “Recent Evidence on the Determinants of Concert Attendance for Mid-Size Symphonies,” Journal of Economics and Finance 31 (3), 412 – 421.

Urrutiaguer, D. (2002): “Quality Judgments and Demand for French Public Theatre,” Journal of Cultural Economics 22, 185 – 202.

Werck, K. / *Grinwis Plaat Stultjes,* M. / *Heyndels,* B. (2008). “Budgetary Constraints and Programmatic Choices by Flemish Subsidized Theatres,” Applied Economics 40, 2369 – 2379.

Werck, K. / *Heyndels,* B. (2007): “Programmatic Choices and the Demand for Theatre: the Case of Flemish Theatres,” Journal of Cultural Economics 31, 25 – 41.

Withers, G. (1977): “Demand for Performing Arts Services,” in The Economics of the Australian Service Sector, edited by K. Tucker, London, Croom Helm, 385 – 414.

– (1980): “Unbalanced Growth and the Demand for Performing Arts: An Econometric Analysis,” Southern Economic Journal 46 (3), 735 – 742.

Zieba, M. (2009): “Full-Income and Price Elasticities of Demand for German Public Theatre,” Journal of Cultural Economics 33 (2), 85 – 108.

Zieba, M. / *Newman,* C. (2007): Understanding Production in the Performing Arts: A Production Function for German Public Theatres, Discussion Paper, Department of Economics, Trinity College, Dublin.

Appendix:
Construction of Variables and Data Sources

Variable	Description
A_{jt}	Total attendance: it is the total number of tickets sold, together with tickets for guest performances, with free and complimentary tickets excluded.
TP_{jt}	Real ticket price: it is calculated by dividing yearly operating theatre revenues by the number of tickets sold (paid attendance) and divided by the Consumer Price Index (CPI).
IN_{jt}	Real income per capita: it is calculated by dividing the disposable income (in the market relevant for theatre *j*) by the population of the relevant market, P_{jt}, and deflated using the CPI.
P_{jt}	Population (market size): it is measured for each market relevant for theatre *j*. The theatre markets were calculated using the spatial weight matrix approach in line with Zieba (2009). Three different matrix specifications were used.
N_{jt}	Number of other theatres. For non-touring (city) theatres, it is the number of public theatres in a city where theatre *j* is located in period *t*. For touring theatres, it is the number of all public theatres in the country in period *t*.
C_{jt}	Total theatre capacity: it is calculated by multiplying the number of all seats by the number of all performances. It is calculated separately for each venue available in theatre *j* in season *t* and it is summed up in order to obtain the total capacity for each theatre.
REP_{jt}	Reputation (guest) index: it is the share of guest attendance in total attendance and is calculated by dividing the attendance at guest performances by total attendance at all performances.
ARW_{jt}	Artistic wages: it is the real gross personnel expenses for artists for the yearly theatre season divided by the total number of artists and deflated using CPI.
DEC_{jt}	Outlay on décor & costumes per artist: it is the expenses for décor and costumes divided by the number of artists and deflated using the Production Price Index (PPI).
$CAST_{jt}$	Cast size: it is the number of artists including artistic management, singers, dancers, actors, musicians, orchestra and choir members and guest artists. The number of guest artists is weighted by a factor of 0.5 in order to account for the fact that they are employed only on a part-time basis.
DIF_{jt}	Product differentiation index: it is the sum of dummy variables $\sum_{k}^{K} D_{jkt}$. The indicator variable, D_{jkt}, takes a value 1 if the specific art form *k* was performed and 0 otherwise.7 dummies are considered: 1) opera, 2) ballet, 3) operetta 4) musical, 5) drama, 6) youth and children's theatre, 7) concerts.
$INNO_{jt}$	Innovation index: it is the number of new productions divided by the number of all productions staged during the theatre season.

Data Source: *Theaterstatistik* 1965 / 1966 – 2004 / 2005. Data sources on income and population variable are the same as those used in Zieba (2009).