

Is it worth subsidising regional repertory theatre?

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Subsidies to the performing arts are usually justified by reference to externality and public goods arguments that are hard to quantify. We suggest that subsidies to theatres may be appropriate because of their inability to engage in spatial price discrimination to capture consumer surplus. For one major theatre, we use audience data and the Clawson–Knetsch travel cost method to assess the extent of consumer surplus and find that it exceeds the level of subsidy received from public sources. On the basis of this example, current subsidy levels are justifiable even without recourse to traditional externality/public goods arguments.

1. Subsidies for the performing arts

Keynes (1945) hoped that the then new Arts Council would 'decentralise and disperse the dramatic and musical and artistic life of the country'. In the subsequent half-century, its critics have argued that subsidies have in fact been over-concentrated on London. Nevertheless, the Council supports a large number of regional producing theatres whose expenditure exceeds revenue. By filling the financial gaps, the Arts Council (and perhaps in future, the National Lottery) may be claimed to be keeping alive a nationwide 'dramatic life' in line with the objective set by Keynes.

But is there a case for subsidising this 'dramatic life' at all? Do taxpayers receive value for money from subsidising drama? A voluminous literature on arts subsidies pioneered by Baumol and Bowen (1966) and reviewed by Fullerton (1991) addresses the first question, but there has been little attention to producing empirical studies that address the second.

Most arguments for subsidies are based on alleged externalities[1]—e.g. non-users of the theatre feel better off because they have an extra option for nights out (option demand); local businessmen, such as restaurateurs, gain business (Myers-

[1] Non-economists often claim that the arts are worth supporting because of their intrinsic merit but Austen-Smith (1994) points out that the imposition of tastes on society is too alien to the history of welfare economics for this line of argument to carry legitimacy in the economics literature. He recalls Bentham's tenet that 'the game of pushpin is of equal value with music and poetry'.

cough, 1988); local residents enjoy pride from the status of local companies; and future generations have a tradition preserved (the presumption being that, with more income and leisure, they will value theatre more highly than those currently alive).

The externality/public goods arguments are all debatable. For example, Peacock (1969) suggests that multiplier effects on the local economy are merely pecuniary externalities and that if pride in local achievements is a species of public good, it might be at least as effectively generated by funding soccer teams. Again, even if the arguments for option value and benefits to future generations are accepted, their evaluation raises formidable informational requirements and it seems unlikely that they could yield a convincing empirical assessment of current levels of support.

However, there is another circumstance in which intervention may be appropriate that fails to be highlighted in the cultural economics literature: monopoly power. Theatre, by its nature, always produces a unique commodity (e.g. one interpretation of Shakespeare may be radically different from another) and all productions therefore face downward sloping demand curves; some monopoly power is always present. This raises a possibility that a theatre demand curve may lie entirely inside the average cost curve, but with some price–quantity combinations that would generate consumption benefit (as measured by the area under the demand curve) higher than total cost. This circumstance has been associated in public economics with utilities, where fixed costs are high relative to variable costs; but, of course, most theatre production costs are also invariant to the number in the audience and theatres may in some sense therefore be like utilities.

In utilities, the problem has been answered by a two-part tariff, which allows the enterprise to capture some of the consumer surplus, but it is hard to envision any closely parallel solution for theatres. In utilities, there can be a high standing charge because all consumers have a high willingness to pay for the first few units per day; in theatres, each production is usually visited only once by each consumer and willingness to pay differs across individuals rather than for different units purchased by the same individual.

An alternative may be to group the plays in a season and charge for the right to purchase any ticket or tickets during the period. This variant of the standing charge is part of the notion of provision by clubs and it is possible that theatres could operate on such a basis. However, one may doubt whether current artistic policies could survive. Most theatres produce a heterogenous set of plays in any season. There may be a shifting audience and those interested only in one type of play would be likely to be deterred by a high membership fee.

Price discrimination between customers is another possibility. Indeed, theatres themselves appear to be masters of discrimination, with cheap tickets almost always available to the unwaged. However, it is argued here that theatres may also need to engage in a quite different, and perhaps non-feasible form of discrimination,

'spatial price discrimination'. This may be needed because theatres draw patronage from wide areas and some customers have to spend heavily on transport whereas more local users have lower costs. If ticket prices are the same regardless of customer location, it is likely that some individuals living locally will gain high consumer surplus: similar individuals from far away are willing to spend much more than locals need to to go to the theatre. If theatres could engage in spatial price discrimination, they would be able to capture significant consumer surplus by charging higher ticket prices for those with short journeys, while seeking to attract individuals with greater travel costs by offering them cheaper tickets. In practice, such discrimination is difficult and, if local authorities help fund theatres, political pressure is likely to be towards giving discounts to local taxpayers. Further, simple spatial discrimination would be insufficient. The necessary trick would be to discriminate between similar individuals needing to travel different distances. Local patrons who would come anyway even if they lived some way off, would need to be charged more (than similar people in outlying areas) while low prices would need to be preserved for that part of the local audience which attends only because the journey is short. The addition of a spatial dimension to the usual problems of price discrimination across individuals ensures that any discrimination is likely to be far from perfect and therefore far from capturing all of the consumer surplus.

It is possible, then, that regional repertory theatre is commercially non-viable but socially valuable. It is thus worthwhile to measure consumer surplus to assess whether it justifies the subsidy evidently needed by such theatres. Certainly, one can argue that measurement of consumer surplus is more tractable a proposition than empirical assessment of the externality arguments and we therefore propose it as an economic tool which can contribute to the debate on arts subsidies. Indeed, it is possible that it could be revealed that the consumer surplus return by itself repays current subsidies so that no further recourse to the externality arguments need be made.

Austen-Smith (1994) objects to many externality arguments for the arts on the ground that they might apply equally to rugby league. The comment could also be made about our approach, which could indeed be extended to any sector where consumers would have to travel from a wide catchment area and where producers have a high ratio of fixed to total cost. The existence of such conditions does not however guarantee that public support would be necessary or justified to support the existence of the facility; this could only be judged empirically for each individual case.

2. Estimating the demand for theatre

Measurement of consumer surplus requires estimation of a demand curve. Previous studies of theatre demand functions (Gapinski, 1984; Abbé-Decarroux, 1994) have adopted a time-series approach which however offers limited scope for examining the demand for UK theatre: very long runs of box-office data may

be required for there to be sufficient variation in real prices. Cross-sectional analysis is therefore adopted here. We employ the travel cost method of Clawson and Knetsch (1966)[2] which is based on the notion that all potential consumers of a recreational facility face a different price, because they have to spend not only on fixed admission fees but also on varying transport costs to the facility. By examining how the propensity to use the facility varies with distance, a species of demand curve may be estimated and consumer surplus evaluated. This technique for measuring consumer surplus has been widely used in the United States in the context of outdoor recreational facilities. The few British applications have focused on the same field.[3]

The zonal travel cost model has problems but those noted in the literature (Turner, *et al.*, 1992) appear less obvious when applied to a theatre. For example, consumer surplus may be overestimated if people enjoy the journey rather than view it as a means to an end; but the journey to a city theatre is less likely to be enjoyed than one through the countryside to a picnic site. Again, evening theatre performances are less likely than countryside attractions to generate multi-purpose trips; further, there is not the problem of visitors spending different lengths of time at the site. A fourth potential problem, that residential location may be endogenous, is again less plausible for a theatre visited infrequently than for a physical environment, such as a national park, consumed, in a sense, daily by local residents. Nonetheless, we will discuss the implications of possible residential location endogeneity in Section 8 below.

We consider then a demand function that may be written as

$$VR_i = f(D_i, X_i)$$

where the visitor rate, VR_i, is the proportion of the residents of location i who use the theatre, D_i is the distance from location i to the theatre, and X_i is a vector of those characteristics of location i which affect attendance. To apply the model requires data on attendance and on characteristics of the locations from which the theatre draws its audience.

3. Audience data

We had access to data collected at the Royal Exchange Theatre, Manchester, which is located in the city's old Cotton Exchange. It enjoys a high national profile[4] and significant subsidy (£1,499,400 in the financial year 1992–3 from which our data are drawn).[5] In February 1993 it presented an adaptation of Dostoevsky's

[2] For an easy textbook explanation of the travel cost method, see Willis (1980, Ch.9); for a major survey, see Smith (1989).

[3] For a survey of UK work, see Turner *et al.* (1992).

[4] *The Independent* (August, 1988) termed it 'Britain's other National Theatre'.

[5] This figure covers subsidies from all public sources (information supplied by the Royal Exchange Theatre).

The Brothers Karamazov. During a week of this production, the theatre marketing department asked about one-tenth of those at each performance to fill in a questionnaire. The response rate, helped by a raffle for participants, was high, and (following a request to the theatre) we processed 656 completed forms. However, only 605 of these were useable; the remainder had incorrect or incomplete postcode information. The total attendance at the Royal Exchange that week was 5,427 and in what follows we assume that the pattern of residential location attributed to the sample was representative of that for the whole audience.

The survey questions were designed to be used for marketing purposes but the key information for us was the respondent's postcode. By using the Post Office Central Postcode Directory (POSTZON), we were able to convert this to a fairly precise measure of residential location. POSTZON consists of a single entry data record for each of the 1.6 million postcodes in the national system. It includes an eight-figure Ordnance Survey grid reference for the first address in each postcode in England and Wales. We were thus able to place the residence of each of our respondents at the south-west corner of a 100 metres square.

Ordnance Survey grid references are in two parts. The first four numbers identify location by reference to a line running north-south; the remaining four digits refer to a line running west-east. By comparing the first half of the grid reference for any postcode with that for the Theatre, we obtained, for the home of each patron, distance to the Royal Exchange measured along the relevant line of latitude. A similar process of subtraction for the second parts of the grid references gave us distance measured along a north-south line. The linear distance between home and theatre was then calculated by Pythagoras' Theorem.

This procedure was needed because the zonal method requires that the catchment area be divided into zones around the facility. Having obtained a list of audience members' postcodes, they could then be allocated between concentric rings at varying distances.

4. Zone formation and characteristics

The data showed that theatregoers travelled from areas throughout the North-West.[6] Therefore, we constructed 20 rings covering an area extending through seven counties. The inner thirteen were constructed at 2 km radial intervals. Since the number of visitors decreased with distance, it was necessary to increase the interval size in order to capture an adequate number of theatregoers in each zone. Thus, after 75% of our sample was picked up by the 13 inner rings, a series of seven outer rings was established at 4 km intervals. Overall, the 20 zones

[6] Verhoeff (1992) found in a Dutch study that performance quality (as graded by a panel of 'experts') was a significant determinant of geographical reach. The Exchange's wide catchment is perhaps therefore a tribute to its standards.

accounted for about 95% of the sample. Most of the excluded 5% claimed to have travelled from much further afield (e.g. London).[7]

To model the relationship between the proportion of the population of each zone that visited the Exchange and the distance to the theatre, we needed, for each zone, population data and some measures of socio-economic characteristics to serve as control variables. The Small Area and Local Base Statistics of the 1991 Census of Population provided appropriate information, accessible using the SASPAC software package (Manchester Computing Centre, etc., 1992). The smallest spatial unit for which census information is provided is the enumeration district, which typically consists of 150 to 300 households. SASPAC allows enumeration districts to be aggregated to form new zones as required and their population and selected characteristics can then be obtained.

The counties included in the catchment area contained 20,966 enumeration districts identified by the grid reference of their centroids. By asking SASPAC to use this information together with the grid reference of the theatre itself and our Pythagoras procedure, we were able to allocate enumeration districts between the zones. Of the 20,966 districts, 14,307 fell within the cut-off radial distance of 54 km. For each zone, census data for the enumeration districts within it were aggregated to provide population and other data.

5. Regression analysis

We report in this section an estimate of a Clawson-type demand function for our play. The dependent variable is the visitor rate (VR), the values for which are displayed in Table 1. VR_i is obtained by dividing the number of people from zone i who saw the show that week by the total adult (15 and over) population of zone i. We sought to explain this visitor rate by the distance of the zone from the Royal Exchange and by control variables. The notion is that we are estimating a species of demand curve where people are thought of as paying for the play in terms of having to travel specified distances to see it. Distance is presumed to be a deterrent to using the theatre.

While we expected demand to fall off with distance, theory suggested no specific functional form. We therefore adopted a very general gravity model in which visitor rate (VR_i) depended on D_i^{λ} where D_i was distance (in kilometres) from zone i to the Royal Exchange and λ was to be estimated using maximum likelihood.

[7] It would of course have been possible to delineate a different number of zones than 20. Our choice was based on balancing the need to make differences in distances to the theatre negligible within each ring against the likelihood that devising too many zones would prevent our achieving a well-defined demand function; the difficulty with creating a very large number of zones would arise because the variation in visitor rates would become more stochastic and harder to relate to economic variables. Again, all our zones take the form of rings. For some types of facility, it would be appealing to divide inner rings into wedges to take advantage or more responses at smaller distances. However, in the case of the Royal Exchange, the number of responses in the innermost ring was relatively small as Table 1 illustrates.

Table 1 Audience by zone

Zone	distance (km)	number of responses	VR_i
1	1	5	0.002652
2	3	15	0.001269
3	5	65	0.003382
4	7	59	0.002682
5	9	46	0.001913
6	11	34	0.001130
7	13	59	0.002095
8	15	50	0.002443
9	17	46	0.002461
10	19	27	0.001796
11	21	23	0.002682
12	23	14	0.001303
13	25	13	0.000910
14	28	22	0.000873
15	32	15	0.000347
16	36	23	0.000446
17	40	10	0.000311
18	44	13	0.000207
19	48	5	0.000079
20	52	24	0.000418

This procedure is economical in terms of degrees of freedom and nests functional forms such as linearity.

Possible control variables included the percentage of zonal adult population of statutory retirement age (retirees may have a lower value of time and also pay discounted ticket prices) and various measures of social class, namely the proportion of the adult population in households headed by members of social classes 1 and 2, the proportion of households owning at least one car and the proportion of the over-18 population educated to diploma, degree, or higher degree level. Such measures of social class may proxy income[8] or (especially in the case of the education variable) may be linked to tastes.

Our initial equation included all these control variables and distance. The coefficients on all three social class measures were significant when included singly, but there was a problem of strong co-linearity between them. Applying a general-to-specific procedure by dropping variables according to statistical significance left the education variable as the sole measure of social class in our final simplified equation. Here, VR_i was hypothesised to depend on a distance variable D_i^{λ}, the proportion of the zone's 18-and-over population educated to tertiary standard ($EDUC_i$), and the proportion of the zone's 15-and-over population of retirement age

[8] The British census includes no questions on individual or household income.

Table 2 Box–Cox estimation: dependent variable VR_i

	coefficient	t-statistic
Constant	−0.00234	0.96
D	−0.00126	−9.16
EDUCi	0.000254	5.84
OLDi	0.000178	1.84
Number of observations		20
R-bar-squared		0.84
F-value		33.84
Mean of dependent variable		0.00147
Standard error of regression		0.00041
Maximum likelihood estimate of λ		0.3208
Marginal effect of distance (1km) (measured at mean)		−0.0000489

(OLD_i).[9] The regression result is shown in Table 2. The optimal functional form had $\lambda = 0.3208$, giving a convex-to-the-origin demand curve in visitor rate–distance space that shifts according to inter-zonal differences in education level and age structure.[10]

Overall, the equation has high explanatory power and the coefficients on the distance and education variables are significant and correctly signed: the demand curve is downward sloping and (if education is taken as proxying income levels) theatre is a normal good. The coefficient on OLD is of the expected positive sign and on a one-tailed test is significant at the 5% level.

A possible objection to our demand equation is that the omission of the prices of substitutes may bias the estimates of the coefficients on the included explanatory variables (and therefore any estimate of consumer surplus). A difficulty is that the specification of any substitutes would be *ad hoc* and here we do not attempt it. We do not believe that this systematically biases our results as it might if the method were being applied to, e.g. the case of London theatres. As distance from a London theatre increased, distance would increase also from almost all of the more obvious substitute sites (other West End theatres): the coefficient on distance from a single

[9] The education and age-structure variables are entered linearly on the assumption that their effects work only through differentials in the probability of attendance between graduates and non-graduates and old and non-old people. In principle, non-linearity is a possibility if, e.g. an increase in the proportion of graduates induces more of their non-graduate neighbours to take up theatre-going. However, it would be unreasonable to impose the same non-linearity on EDUC and OLD as on D and to estimate a different λ for each variable would be costly in terms of degrees of freedom. Given that D varies much more than EDUC and OLD, it is much more important to allow for non-linearity with respect to distance and this is the basis of our specification of the Box–Cox equation to be estimated.

[10] We tested our model for evidence of different types of heteroscedasticity. Using the Goldfeld–Quandt procedure, we examined whether the variance of the residuals was related to POP_i, $EDUC_i$, or OLD_i and found no evidence of such relationships. For POP_i, $EDUC_i$, and OLD_i the F-statistics were 0.16, 0.43, and 2.11 respectively. The 5% critical value for F was 5.39.

theatre included in a regression equation would therefore be biased; the estimated demand curve would be steeper than the true demand curve and the consumer surplus would thereby be exaggerated. In the case of Manchester, by contrast, the most obvious substitute goods may be offered by repertory theatres in other towns such as Bolton, Oldham, Crewe, Stoke, Leeds, and Liverpool. There is therefore no systematic relationship between distance from the Royal Exchange, measured by reference to concentric zones, and distance from substitute theatres and therefore no reason to suspect that any error in the estimation of consumer surplus would fall in a particular direction.

6. Consumer surplus

We now proceed to estimate consumer surplus. Our demand curve is in distance-visitor rate space, so our consumer surplus estimates will for now be in kilometre units: the underlying assumption is that a willingness to pay for the play comprises a willingness to pay the ticket price (invariant with respect to household location) and, in addition, a willingness to undertake journeys of a certain distance. We take consumer surplus as capable of being measured by the difference between the distance a person is willing to travel and the distance that person actually has to travel.

Consumer surplus was calculated separately for each zone. We began with the demand function which had the form

$$VR_i = a_0 + b_1 D_i^{\lambda} + b_2 \mathrm{EDUC}_i + b_3 \mathrm{OLD}_i$$

We then substituted the actual values of EDUC_i and OLD_i to obtain a demand curve with a zone-specific constant, $k_i = a_0 + b_2(\mathrm{EDUC}_i) + b_3(\mathrm{OLD}_i) : VR_i = k_i + b_1 D_i^{\lambda}$.

This demand curve is of course in terms of visitor-rate (VR_i). For consumer surplus calculations, we need to convert it to be in terms of visitor numbers (V_i) and we do this by multiplying through by the zonal 15-and-over population, POP_i, to obtain

$$V_i = k_i(\mathrm{POP}_i) + b_1 D_i^{\lambda}(\mathrm{POP}_i)$$

and, for further convenience, the constant in this zonal demand curve is written below as K_i (where $K_i = k_i(\mathrm{POP}_i)$).

The consumer surplus for zone i, is then

$$CS_i = \frac{\lambda b_1^{-1/\lambda}}{1+\lambda}[K_i^{(1+\lambda)/\lambda} - (K_i - \hat{V}_i)^{(1+\lambda)/\lambda}] - D_i \hat{V}_i$$

where $\hat{V}_i$ is the value of V_i fitted for zone i from the regression equation.

For each zone we calculated consumer surplus using our fitted values of V and our estimates of b_i and λ from the regression above. The results of the exercise are

Table 3 Consumer surplus estimates, by zone, in kilometre units

Zone	distance(km)	POP_i	$EDUC_i$	OLD_i	consumer surplus
1	1	18,011	9.12	21.89	506.89
2	3	112,931	8.43	21.89	2,106.94
3	5	183,607	11.47	23.35	10,095.32
4	7	210,184	11.79	23.75	12,363.00
5	9	229,783	11.13	23.80	10,377.85
6	11	287,595	8.92	22.83	3,992.61
7	13	269,137	12.38	22.48	11,125.80
8	15	195,558	14.38	21.19	10,365.95
9	17	178,557	14.17	22.47	10,776.05
10	19	143,644	17.79	20.99	16,047.82
11	21	81,928	17.51	19.95	6,735.74
12	23	102,655	13.20	22.14	3,247.95
13	25	136,563	12.06	22.39	2,560.26
14	28	240,839	12.08	20.56	1,662.48
15	32	413,613	10.81	22.29	1,722.55
16	36	492,881	11.99	21.57	2,421.71
17	40	306,949	10.68	21.17	2.27
18	44	601,112	11.36	22.99	1575.11
19	48	606,265	9.73	22.43	0.00
20	52	548,099	12.10	23.95	2,863.03
Total					110,549.41

shown in Table 3.[11] The total value of consumer surplus for the week was 110,549.42 kilometres.

The spatial pattern of consumer surplus is influenced not only by the distance cost that has to be paid by theatre-goers from each zone, but also by population densities and by the relative values of the EDUC and OLD variables across zones. The strong influence of EDUC in positioning the demand curve is particularly apparent from Table 3 and accounts for the low benefit to the innermost zones and for the rapidity with which consumer surplus falls off beyond 20 kilometres from the theatre.

It is interesting to note that a substantial proportion (44%) of the consumer surplus accrues to residents in areas 12 to 20 kilometres from the theatre. Given the tightness with which the boundaries of the central city are drawn, most of these areas lie within neighbouring municipalities. To the extent that subsidies are partly the responsibility of local government, it would seem equitable, on the basis of our results, that institutional arrangements should ensure that the

[11] Note that for one of the zones, the second-most distant from the theatre, the fitted value of V was negative and therefore a zero consumer surplus was attributed. A semi-log functional form would eliminate any possibility of negative fitted values and some authors prefer it on this ground. However, in calculating a 90% confidence interval for λ, we found that the value of λ implied by a semi-log functional form lay outside its boundaries.

central city councils in metropolitan areas should not be asked to bear more of the burden than outer-ring local authorities.

7. Is the consumer surplus large enough to justify subsidy?

The usefulness of our method rests on it being possible to interpret a willingness to travel certain distances as a willingness to spend corresponding sums of money. Consideration is therefore needed on how to convert kilometres to pounds.

Travel costs comprise time costs and direct monetary costs (e.g., on fuel or bus fares). We sought typical values for these two components on a per kilometre (return) journey basis and in the context of the Greater Manchester area in the evening.

On time costs we took advice from the Greater Manchester Passenger Transport Executive (GMPTE) on traffic speeds in the county on weekday evenings. Typical speeds for cars and buses were 36 and 24 kilometres per hour respectively. For the 75.6% of our sample who used cars, each 1 km of distance from the theatre therefore involved 'expenditure' of $3\frac{1}{3}$ minutes (taking into account both outward and return journeys). For the rest of the sample we took buses as the representative mode. Travelling by bus is estimated to take one-third longer than car per kilometre travelled.

Having estimated travel time per kilometre, we converted this to a money figure by using the standard 'behavioural value of (non-working) time' used by the Department of Transport in predicting motorists' response to capital schemes. Based on a large number of commissioned empirical studies (Department of Transport, 1987),[12] this official value of time is index-linked to average employee earnings (including overtime and excluding those with absences) as recorded in the *Department of Employment Gazette*. Indexing to the month of our data yielded a valuation of time of £3.718 per hour or 6.200 pence per minute.

We used this official behavioural value of time because it represents a consensus derived from many studies and because we, like the Department of Transport, are using it to model the demand to travel. Again, since we are assessing the value-for-money of government arts spending it seems appropriate for consistency to value time on the same basis as policy advisors in other expenditure areas. Of course, we might have adopted a higher value than the standard because theatregoers (given the strength of the coefficient on our education variable) can be presumed to be much better off than average and their time therefore valued highly. Nevertheless, we retained the standard value as the basis of calculations so as to give a cautious estimate of the benefits of the theatre.

[12] The commissioned studies relate mainly to commuter behaviour. On the problem that time may be valued differently at other times of day there is limited evidence but Winpenny (1991) quotes a US study in which leisure time is separately valued and attributed a value in the same range as that used here.

Taking the value of time as 6.2 pence per minute, we calculated the time cost per km return trip to the Royal Exchange as 20.65 pence for car drivers and 27.53 pence for bus users. This gave a weighted average for all theatregoers of 22.33 pence per km return.

For the direct costs of car travellers, we used 'running costs per mile' as recorded in Automobile Association (1993) for vehicles with an engine capacity in the 1401–2000 cc range. For April, 1993 this was 16.50 pence per mile. It could be argued that this understates marginal cost because depreciation is allocated to 'standing charges' by the AA whereas some element of depreciation may be mileage-related. This would suggest that using the 16.50 figure would bias our end results downwards. On the other hand, motorists might underestimate marginal cost and consider only fuel useage. In this case, the 16.50 figure would lead to our results being biased upwards. We decided to base our calculations on the 16.50 pence estimate but report below how our results would change if we adopted a fuel-only costing basis.

The AA figure of 16.50 pence per mile of travel translated to 20.50 pence per km return. This is a per vehicle cost but we need a per person figure. The modal party size in our sample was two (with one the next largest) and we therefore spread the cost across two people to give a per km return figure of 10.25 pence.

For bus travel, the GMPTE advised that 25 pence per mile was a fair estimate of the average level of regional prices in 1993. Incorporating this figure (as 31.07 pence per km return) into our calculations yielded a weighted direct cost of travel for all theatregoers of 15.33 pence per km return. Combining this with time costs, each km of return journey was calculated as costing the theatregoer 37.66 pence and this is the basis of our translation from a kilometre to a pounds consumer surplus estimate.

Following this methodology, we calculated the consumer surplus for the week as £41,632.91. The Royal Exchange assured us that our figure is for a week when the level and pattern of ticket sales was typical of that for the year.

The level of public subsidy for the year 1992–93 was (as noted above) £1,499,400. The Theatre produces for 48 weeks per year and therefore the subsidy on a per-week of performances basis was £31,237.50. Our week yielded a consumer surplus benefit that was higher than this : the net benefit for the week was £10,395.41 with a benefit: cost ratio of 1.33. If the week was typical, subsidies generated a return very close to £500,000 for the year.

We tested the robustness of our finding with respect to functional form by deriving a 90% confidence interval for the value of λ in our regression. We used the upper- and lower-bounds of λ to obtain fresh estimates of consumer surplus. We established that, even adopting the cautious approach of measuring at the (unfavourable) extremity of the 90% confidence interval, the benefit-cost ratio remained comfortably above unity at 1.16.[13]

[13] Using the lower-bound estimate of λ gave a benefit-cost ratio of 2.04. Throughout the range 0 to 1, lowering the value of λ would raise the estimate of consumer surplus and therefore the benefit-cost ratio.

Table 4 Ratio of consumer surplus to public subsidy under varying assumptions

Assumption	benefit-cost ratio
Central assumptions	1.33
λ at lower-band of 90% confidence interval	2.04
λ.at upper-band of 90% confidence interval	1.16
Car travel at 72 km per hour beyond 15 km radial distance	1.29
Motorists perceive only fuel elements in car costs	1.18
Fuel costs only and λ at upper-bound of 90% C.I.	1.03

A further sensitivity test checked whether a different assumption on traffic speeds would alter our findings. Congestion for theatregoers in the evening, given that they are inbound in the late rush-hour, is unlikely to be serious. However, motorway driving may allow faster speeds than 36 km per hour to be achieved by some travellers. Manchester is well-served in that (except to the East) it is boxed by a ring-road motorway with interchanges to the national system. We therefore recalculated costs to allow for car speeds to double (to 72 km per hour) for all parts of their journey beyond 15 kilometres from the theatre; this would reflect the ability of motorists to use motorways for some of their route outside the box. This made only a small difference to the benefit-cost ratio, reducing it to 1.29.

As a final sensitivity test, we re-performed our calculations on the basis that motorists perceived only fuel costs. Using a 'petrol-only' AA figure of 7.58 pence per vehicle mile yielded a revised benefit-cost ratio of 1.18. Even when this costing basis was combined with measurement at the (unfavourable) extremity of the 90% confidence interval for λ, the benefit-cost ratio still remained above unity at 1.03.[14] The finding that current subsidy levels were repaid in consumer surplus was therefore hard to reject. Outcomes of the sensitivity tests are summarised in Table 4.

8. Qualifications

In this section, we draw attention to possible residual sources of bias in our results.

8.1 Consumer and producer surplus at other locations

We are mindful that some of the apparent advantage of maintaining the Royal Exchange in existence may be illusory to the extent that some patrons might be just as satisfied if they attended another of the region's theatres instead.[15] In this case, our measurement of consumer surplus would exaggerate the case for subsidy. How serious this is likely to be will depend on the characteristics of the audience. Some will be theatre buffs who would always attend the other theatre's production

[14] In this case, the benefit-cost ratio at the other end of the confidence interval was calculated as 1.62.

[15] Because of the wide catchment area, the alternative theatre may be in Manchester or in one of the other regional centres.

anyway. For such individuals, the willingness to pay measured by their position on our demand curve will fairly represent the degree of consumer surplus obtained. A second group of individuals will have particular tastes and would not attend an alternative even if denied the chance to see *The Brothers Karamazov* at the Royal Exchange. Again, for these patrons, the willingness to pay shown on the demand curve will capture their benefit from the provision of our particular facility. The problem arises only from a third type of individual for whom (in the extreme case) a night at the theatre is wanted and he would be just as satisfied, at least *ex ante*, by any other show at a theatre a similar distance from his home as the Royal Exchange. For these individuals, the apparent consumer surplus generated would not in fact be lost if the Exchange closed.

The problem cited is only important if our third type of individual is significantly represented in the audience. In fact, this category comprises only a minority. An Arts About Manchester report on the survey used here noted that, in response to a question on motives for attending the performance, 68% cited good reviews, 51% referred to the quality of the actors, and 48% wanted to see the particular play. By contrast, only 4% said it was a special occasion and only 21% ticked a box labelled 'an evening out'. Moreover, the report found that most of the audience had not been to another Manchester theatre in the preceding 12 months. These results are unsurprising. Theatres offer highly heterogenous products and we would have judged anyway that many of the audience for a classical play would not regard (say) a modern, social-issues orientated production offered by a company with a different house style in another building as anything other than a highly imperfect substitute. Further even, if significant numbers were willing to transfer their custom to the rival show if the Exchange closed, they would displace some existing patrons in that other theatre either because of capacity constraints or because it responded to the demand shift by raising ticket prices; there would therefore still be some loss of consumer surplus to enter into the assessment.

The issue of producer surplus at rival entertainment facilities must also be mentioned to the extent that the existence of the Exchange may reduce patronage elsewhere. Again, the significance of the bias in our case will depend on the extent to which consumers consider the products to be close substitutes rather than the highly differentiated goods that they appear to be.

8.2 Endogeneity of residential location

Productions at the Royal Exchange typically run for more than a month, so the number of plays offered in the year is limited. This makes it implausible that many people will modify their choice of residential location because of the existence of the theatre. However, central Manchester has many other night-time attractions such as concerts, indoor sports, and restaurants. It is therefore likely that individuals with a taste for things cultural will tend to be disproportionately concentrated close to the city leaving more outlying areas to include disproportionately large numbers of those whose preferences run more to (say) gardening. This will

lead to a bias in our estimated demand curve because of omission of a relevant variable, taste for cultural activities. Because the omitted variable will be negatively correlated with distance, the absolute size of the estimated coefficient on distance will be subject to upward bias: distance will appear to be a greater deterrent to attendance than it really is. This will lead to downward bias in our estimate of consumer surplus and in the consequent case for subsidy; but the degree of bias is unknown.

8.3 Measurement of distance

Our model was based on linear distance but having to travel via roads ensures that this will underestimate actual distance. The travel cost we associate with the coverage of given measured distances will thus understate actual travel costs. Our translation from consumer surplus measured in kilometres to consumer surplus measured in pounds will therefore be a source of bias.

The direction of bias is clear—it will lead to the understatement of money consumer surplus and to an understatement of the benefit from subsidy. Some informed speculation on the degree of bias is possible. In another project, one of the current authors examined the spatial demand for watching Premier League soccer. Employing the responses to a survey carried out by the Leicester Football Research Centre, he regressed respondent-reported distance on linear distance (calculated as here). The exercise revealed a strong consensus that to cover a given linear distance requires travelling on the ground a distance some 28% greater. If theatre-goers have similar perceptions, it would be justified to increase our estimate of consumer surplus (and the benefit-cost) ratio by that proportion.

9. A measurement of demand elasticity

Although the consumer surplus generated by the availability of plays at the Royal Exchange appears to be greater than the subsidy, this is not quite sufficient to justify the subsidy and its current level. It is possible that the theatre could vary its prices to improve its financial position and thereby reduce the need for subsidy. To check this possibility, we attempt to measure elasticity of demand with respect to ticket price.

Our demand curve is drawn with respect to distance. We use distance as a proxy for travel costs and our central estimates assume that an increase of 2.66 km in distance is equivalent an increase of £1 in the cost of attendance. We continue this assumption by assuming that a £1 increase in ticket price would have the same effect as shifting the population of each zone outwards from the theatre by 2.66 km.

For each zone separately, we calculated $(d\hat{V}_i/dT) = 2.66\mathrm{POP}_i(d\hat{V}R_i/dD_i)$ where T was ticket price. Elasticity was then

$$\left(\sum_{i\neq 19}\frac{d\hat{V}_i}{dT}\right)\left(\frac{T}{\sum_{i\neq 19}\hat{V}_i}\right).$$

The ticket price used in the evaluation was £9.50 (the mean paid that week). We estimated elasticity with respect to ticket price to be −1.24,[16] which is not very far from that which a revenue maximising management (without capacity constraint) would generate from its choice of position on the demand curve. Calculations of elasticity for individual zones revealed inelastic demand in areas with the largest values for the EDUC variable but elastic demand elsewhere.

Our estimate implies that it would be unwise to raise prices (given that the marginal cost of selling a ticket must be low): a simulation of the impact of raising price by £1 indicated a fall in sales from 5,427 to 4,778 giving an arc elasticity of −1.11.[17] On the other hand, price cuts to stimulate demand and increase revenue would make little dent on the subsidy since demand is only slightly elastic and, in any case, on a journey down the demand curve the theatre would quickly encounter a capacity constraint: there were less than 300 seats unsold in the week of the production (though the house was never completely full).

The scope for the theatre to reduce dependence on public funds by varying ticket prices thus appears limited. Since marginal cost is low (perhaps little more than agency commission and bank charges), the elasticity estimate is consistent with profit-maximisation. That this results in near-full use of capacity indicates that the recent decision to retain the same size of theatre (in reconstruction following bomb damage) was appropriate.

10. Conclusion

The overall net benefit figure estimated in this paper is perhaps modest. Recall however that there is a large literature seeking to justify subsidies to the performing arts on an altogether different basis. Because these other arguments are hard to quantify, we set out to assess for one case study whether current subsidies can be justified simply on the basis of a consumer surplus return. For our example, the current level of subsidy was found to be justified. Those who believe that the arts generate significant externalities would no doubt argue that higher levels of subsidy should be granted to reflect the extra benefits ignored here. In any case, application of our methodology to other examples seems likely to be worthwhile in terms of informing the general debate on the level of public support for the arts.

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[16] Zone 19 was excluded from the calculation because predicted visitors from the regression equation was negative: for any small change in price, visitor numbers would therefore be expected to remain at zero.

[17] The reduction of 649 is calculated with the constraint that visits from a zone must be non-negative. With a £1 increase in prices, visits from zone 17 are predicted to fall to zero. The estimated effect on gross revenue of the £1 price increase is −£1,269 for the week.

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