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Abstract: Governments in most of the developed world fund arts and culture either directly or indirectly. Theoretially, the arguments are based on the arts and culture being public goods or providing positive externalities. The size of the externalities for a variety of cultural goods has been empirically investigated in numerous stated preference studies. However, the existence of externalities has not previously been tested as a causal relation. While the public benefits are mostly related to the supply of a cultural good, there are also expected to be externalities are related to the consumption. We call them cultural-capital externalities, and the expectation is that private consumption jointly produces a private and a public good. The important point is that these consumer externalities are transmitted through the individuals (users) consumption by means of social activities and interactions among human beings. Without the consumption by the users, no public good benefit or externalities are produced. In this paper we exploit variation generated by a national ticket purchasing scheme to estimate the causal effects of theater consumption on public returns. As an indicator we use individuals' WTP for theatres measured in a contingent valuation study. Exploiting differences in municipalities' age distribution as an instrument for the total number of theater visits, we find that there are significant cultural-capital externalities for users, but we find no effects for non-users. An important limitation of our study is that citizens' WTP is used as an indicator for the size of cultural-capital externalities. However, our study shows that it is possible to test the existence of externalities of cultural consumption in an empirically convincing causal set-up. In future research, there is a need for finding better outcome measures than WTP.

Keywords: quasi-public good, cultural-capital externalities, performing arts.**JEL No.**Z18, H23,H44.

1 Introduction

Governments in most of the developed world fund arts and culture either directly through subsidies or indirectly through tax exemptions for private donors. The economic arguments are based on the expectation that the arts and culture having public good characteristics and generate externalities (Throsby, 2001, Snowball, 2007, Pommerehne and Frey, 1989). Government policies are often justified on the basis of these externalities (Frey, 2019 and Towse and Hernández, 2020).

Many studies have investigated the perceived external benefits of cultural goods. These studies typically rely on stated preference methods, and the focus has been on assessing whether or not the public expenditure is worth the money from the taxpayer's point of view. Across studies, a somewhat stylized fact has emerged. Those who never or seldom use the cultural goods in question still claim to value them[1]. Since the function of value is to provide a quantitative measure of utility these findings imply that although no market-based consumption takes place individuals might still derive satisfaction from these goods. Hence, these findings have generally been interpreted as evidence in favor of external benefits. These external benefits have been thought to arise because the consumers can maintain an option for future consumption (option value) or other individuals or future generations to have the possibility to consume the cultural good (bequest value). Furthermore, benefits like existence value (especially for cultural heritage) or prestige value have been suggested. All these benefits relate to the supply of a cultural good. A special case arises when the externalities are related to the consumption of a cultural good. These externalities will be explored in this paper.

While cultural externalities can arise through consumption of various cultural goods, we limit the attention to theaters in this paper. The question we ask is whether individuals who consume theaters directly influence the welfare of others within their respective community, as would be expected if cultural-capital externalities are present. We refer to these externalities as *cultural-capital externalities*, because they are related to the effect on other individuals through an increase in consumption of theatres. The expectation is that cultural consumption will have positive social benefits, i.e. in the form of building community identity or through moral education by promoting tolerance and acceptance (Klamer, 2004 and Denti et al., 2022).

To this end, we explore the relationship both theoretically and empirically. First, we extend a quasi-public goods model to include communities and provide comparative statics in the dual to the direct demand system. The model describes the private benefits that theater users derive from attending performances and those external benefits imposed on all individuals within a community as a result. Furthermore, we show that the theoretical sign of the putative externalities is, in fact, ambiguous. The theoretical sign depends on whether or not individuals' consumption of theaters increases with the amount of the public good provided. Our augmented model is quite general and can easily be extended to analyze other cultural goods such as museums.

We use the insights from the theoretical model to derive an empirical model of the relationship between valuation and the total number of visits within a municipality. Although, our empirical model rests on a theoretical foundation, it is not necessarily given that it captures the causal effect

[1] Sanz et al., 2003 find that non-users value the National Museum of Sculpture of Valladolid just as much as users. Hansen, 1997 finds that, on average, non-users are willing to pay DKr 137 through their taxes a year for the Royal Danish Theatre. Czajkowski et al., 2017 Finds that those who are very likely not to attend theaters still have a positive valuation. For an overview see Noonan, 2002

of interest. It is quite likely that valuation and the number of theatergoers within a municipality are affected by the quality of theaters or the attainable information level. In addition, since theater going is often a joint decision, individual preferences may also confound the relationship. Even if nothing confounded the relationship, measurement error in the number of visits might bias the effect. Therefore, to estimate the externalities, or external returns, we need a source of exogenous variation in the total number of visits within a municipality. This paper proposes an instrument that has not been used before to the best of our knowledge. We exploit a natural experiment provided by a national ticket purchasing scheme. The experiment stems from the fact that individuals below 25 years of age receive a discounted price on their theater tickets. Basic economic intuition suggests that a discount causes a movement along some individual's demand curve and an extensive response for others. Hence, some may choose to buy a theater ticket because of the scheme but would not have done so without the discount. These individual responses should naturally be reflected in the total number of visits within a community. As a result, municipalities with a younger age distribution should have more theatergoers than those with an older distribution because they have a larger share of discount-eligible individuals.

The implied exclusion restriction is that conditional on covariates, the share of individuals below 25 years of age within a municipality does not affect a person's valuation of theaters other than through its effect on aggregate demand[2]. In principle, the share of young individuals may be correlated with omitted factors that also affect aggregate demand and valuation. If so, the validity of our approach is threatened. However, we provide evidence suggesting this may not be a problem. One cause for concern is the effect a larger share of young individuals may have on the type of theater supply, which may alter the perceived benefits of theaters. However, we find no relationship between the type of supply and young individuals within municipalities. Another concern is potential homophily in preferences. If individuals prefer that other theatergoers are similar to themselves, a larger share of young theatergoers may directly interfere with the unobserved preferences. Nevertheless, for this to be true, individuals should be able to predict the "types" of theatergoers for a given performance at the time of purchase. We believe this is unlikely to be the case and that our exclusion restriction is plausible.

OLS estimates using data from a Danish Contingent Valuation study carried out in the first half of 2020 show a positive effect between aggregate demand and valuation. A one percent increase in the number of visits within a municipality is associated with a 0.203 to 0.418 percent increase in average valuation or welfare. Yet, the effect is not significant in our main specification. In contrast with the OLS estimates, the IV estimates of the external returns range from 0.333 to 0.652 percent. Despite being slightly larger, the IV estimates are not significantly different from the OLS estimates. Furthermore, these estimates are not significant in our main specification. We also estimate our model on two sub-samples. The IV estimate of the external return for theater attendees ranges between 0.436 and 2.759, depending on specification. All of the estimates are highly significant in all our specifications. However, the external returns for those who never or seldom go to the theater are significantly smaller and insignificant. We find external returns for this sub-sample between 0.170 and -1.224. None are significantly different from zero.

Therefore, based on these findings, we conclude that there is little evidence for the assumption that theater consumption yields positive external benefits. Only those that use theaters regularly tend to

[2] For the list of covariates included see table 1

benefit from them, not everyone within a community. A direct theoretical implication of our results is that theaters may best be described as a *club good* and not as a *quasi-public good*. The hallmark of *clubs* is that users derive external benefits from other users' membership. The policy implication of this is clear. Standard club theory has shown that they can provide an efficient allocation without government involvement (see e.g., Buchanan, 1965, Musgrave, 1973, Cornes and Sandler, 1996 and Hindriks and Myles, 2013).

There are several shortcomings to our approach. First, our approach only identifies local externalities. We may not capture any externalities that potentially arise across municipalities. Though, intuitively, it seems reasonable that these externalities have a strong local component. Second, our IV estimates using age distribution variation mainly apply to municipalities whose total visits are between 3,700 and 31,000. In comparison, the average number of visits across municipalities is roughly 16,000. Without the reference group, consisting of 18 municipalities, our estimates capture the external returns in 65 out of 80 municipalities in Denmark. Third, our measure of individuals' benefits is based on stated preferences and may therefore not reflect their *true* value. If, for example, theater attenders systematically overestimate their true preferences and non-users systematically underestimate, our results may not capture the *true* effect. More research is therefore needed to corroborate our results. Preferably using alternative methods. A useful starting point may be to investigate our proposed theoretical models prediction. The model predicts positive external benefits if individuals' consumption is complementary to the community's consumption. In effect, this omits the need for a measure of individual valuation.

The next section discusses the arguments put forward for the existence of externalities. In addition, it outlines our theoretical model of theater consumption. Section 4 describes the Contingent Valuation study, our sample, and provides summary statistics. Moreover, we also present OLS estimates for the relationship of interest. Section 3 outlines our econometric framework and identification strategy. Section 6 presents the IV estimates for various specifications and sub-samples. Lastly, section 7 concludes.

2 Theories of cultural externalities

Several non-market benefits have been proposed regarding cultural consumption. In what follows we discuss some of the proposed possibilities of how externalities might arise and derive a theoretical relationship to be estimated.

2.1 Non-pecuniary externalities

In their seminal book Baumol and Bowen, 1966 argues that performing arts may best be described as a quasi-public good which confer direct benefits on those who attend performances, but which also offer benefits to a community as whole. As early as 1963, Robbins argues that "...the benefit is not merely discriminate... the positive effects of the fostering of art and learning and the preservation of culture are not restricted to those immediately prepared to pay cash but diffuse themselves to the benefit of much wider sections of the community in much the same way as the benefits of the apparatus of public hygiene or of a well-planned urban landscape". Hence, Robbins identifies social benefits arising arts and culture. Pommerehne and Frey, 1989 has identified several types of externalities and non-market benefit in relation to arts and culture. They mention option value, prestige value, bequest value, existence value and education value. These social benefits or externalities are non-rival and non-excludable and escape the ordinary market. In the following we will further describe these potential non-market benefits.

Cultural institutions may give rise to option value. While some individuals benefit from theaters because they continually experience them, there likely exist individuals who, although they are not currently visiting them, still value them because they are available as an option (see e.g., Weisbrod, 1964, **schmalensee˙option˙nodate**, Bishop, 1982, Snowball, 2007, and Towse and Hernández, 2020). This is a particular type of demand which shall be referred to as option demand throughout the paper. Option demand applies to many goods and services. Hospitals and green areas such as parks are prominent examples. In this regard, the inhabitants of, say, Copenhagen value the Royal Danish Theater because it is there for them to attend should they wish (Bille, 2002; Bille Hansen, 1997). Hence, it is paramount that the theater receives funding, because otherwise, the individuals would not be able to exercise this option because it may no longer exist.

Secondly, there can be prestige conferred on a community by its arts and culture. In this view, individuals may value, or derive utility from, a theater not necessarily because they want to attend it, but because it is respected nationally or internationally. Hence, theaters since they may be either visited or admired possess both use value and prestige value. Individuals who take no interest in opera may still value it because they take pride in the recognition of the singers, the creativity of the choreographers or the nationalistic aspects, much like many takes pride in their local football teams or music scene (prestige value). Alternatively, individuals might derive disutility from the thought of their country or community being known as a cultural desert.

A third type of social benefit that may arise because individuals, whom might seldom or never interact much with their cultural institutions, yet feel it is important to preserve the opportunity for future generations to do so (bequest value). Likewise, arts patrons might as well believe it is important to preserve the arts for posterity. In order to provide the option for future generations to enjoy arts and culture it requires support in the present. In the specific case of theaters, this amounts to the music that has been written and the drama and choreography that has been created. The other part is the tradition of performing, dancing, writing, acting, and the like. The argument hinges on the presumption that preserving both a community's store of value and the traditions of expressing them is a benefit from which no individual can be excluded (Grampp, 1989).

While option value, prestige value, bequest and existence value are related to the supply of the good and may exists independently of the size of the demand, another type of social benefit relates to the consumption of arts and culture and are expected to increase with the increase in demand. Klamer, 2004 has suggested that the consumption of arts and culture has important consequences for moral behavior within a community. Those who go to the movies, read literature, attend concerts or performing arts indirectly contribute to the moral knowledge by reflecting upon and engaging with societal problems. Hence, the argument is that arts consumption contributes towards a public good which generates positive externalities by building up tolerance, acceptance, or trust within communities through on-going conversations. Consumption of the arts may increase social responsibility of individual citizens prompting them to become less likely to commit crimes (Sawers, 1993).

Although, no empirical research has investigated this relationship Scitovsky, 1972 has proposed a similar argument. The argument is that human beings crave excitement and stimulation which be satisfied through illicit means such as violence or crime or through elicit means such as arts consumption. Hence, according to Scitovsky more arts consumption within communities should displace more obnoxious outlets for human beings' cravings. From an economic perspective, the increase in moral behavior may strengthen social cohesion and collaboration, which are all vital for economic performance (see e.g., Guiso et al., 2006 and Fehr, 2009).

All the latter externalities are related to the consumption. We can call them cultural-capital externalities, as they will increase with the quantity of consumption of a cultural good. It is existence of these cultural-capital externalities we are testing in this paper. We are doing it based on a model inspired by Cornes and Sandler, 1984, 1994, 1996, where a private consumption jointly produces a private and a public good. This is, for example, the case for a theatre, where there are obvious private benefits of attending a theatre performance, and where some consumer externalities are expected to be produced through the private use in the form of the impact on other individuals' welfare, and thereby producing externalities. The important point is that these consumer externalities are transmitted through the individuals (users) consumption by means of social activities and interactions among human beings. Without the consumption by the users, no public good benefit or externalities are produced.

2.2 Theater as a quasi-public good

As discussed in the previous section, theater consumption yields private benefits and may also give rise to social benefits. In this section, we proceed along the lines of these ideas and discuss them more formally. We model theater consumption as a quasi-public good inspired by Cornes and Sandler, 1984, 1994, 1996, but extended to include communities. Furthermore, to bridge the gap between our theoretical and empirical model, we analyze the comparative statics entirely in the dual to the direct demand system.

Individuals live in communities indexed by $m = 1, 2, ..., M$ with N individuals in each. Each individual receives an exogenous money income denoted by I, which can be used to purchase two commodities, c and q. c is a standard composite numeraire private good whose price is set to unity throughout. Because c is a private good, it generates one unit of a private characteristic denoted by c. The commodity q signifies the individual's consumption of theaters, which can be thought of as tickets to a specific performance. One theater ticket costs p and, once bought, generates β units of a characteristic, x, together with γ units of a third characteristic, z. x is a private characteristic that depends on the individual's consumption of theater tickets, q. For individual i living in community m, the total consumption of the third characteristic is characterized by:

$$Z_m = z_{im} + \sum_{i \neq j}^{N-1} z_{jm} = z_{im} + \widetilde{Z}_m \tag{1}$$

Or using the technological condition that augments tickets bought into the third characteristic, (1) can be expressed as:

$$\gamma Q_m = \gamma \left(q_{im} + \sum_{i \neq j}^{N-1} q_{jm} \right) = \gamma \left(q_{im} + \widetilde{Q}_m \right) \tag{2}$$

This specification implies that the third characteristic is purely public. Hence, the quantity generated by any single individual is automatically made available to all others in the community. This external benefit is captured by $\widetilde{Z}_m$. Even if an individual i does not choose to buy a ticket for a performance, thereby contributing towards the public good, i can still consume the public characteristic generated by others in the community. If an individual i choose to consume art, it has three different effects: It increases i's consumption of the private characteristic, it increases i's consumption of the public characteristic, and it increases the quantity of the public good available to each of i's fellow citizens in the community.

Given these characteristics the individuals utility in a given community is defined by:

$$u_{im} = u(c_{im}, x_{im}, Z_m) \tag{3}$$

Assume that $u_{im}(\cdot)$ is a positive and strictly quasi-concave utility function i.e., $u'_{im}(\cdot) > 0$, $u''_{im}(\cdot) < 0$. The individual maximizes utility subject to two constraints. The first constraint is the usual budget constraint which relates the individuals exogenous income, I, to the marketed goods:

$$I_{im} = c_{im} + pq_{im} \tag{4}$$

The second constraint, which is a quantity constraint, relates to how the expectations of the individual form regarding the contribution of other individuals' generation of the public characteristic. This constraint is important because it describes the behavior related to externalities. To see why note that individuals in a community can benefit from the consumption of others without paying a price. However, because the price is zero, individuals would generally want to consume more than is currently supplied because it is free. In this sense, consumption of the public good aspect of theaters is quantity constrained by the level provided by others in the community. Using (1) we define this expectations as $\widetilde{Z}_m \equiv Z_m - z_{im}$. We adopt the Nash-Cournot assumption, which implies that an individual regards $\widetilde{Z}_m$ as exogenously determined in a given community m.

The budget constraint is cast in terms of goods and the second constraint in terms of characteristics. Furthermore, the underlying preferences are expressed in terms of characteristics. It is helpful to redefine the budget constraint in characteristic space to ensure consistency. Using the technological conditions that relate characteristics to commodities, $x_{im} = \beta q_{im}$ and $z_{im} = \gamma q_{im}$, (4) can be expressed as:

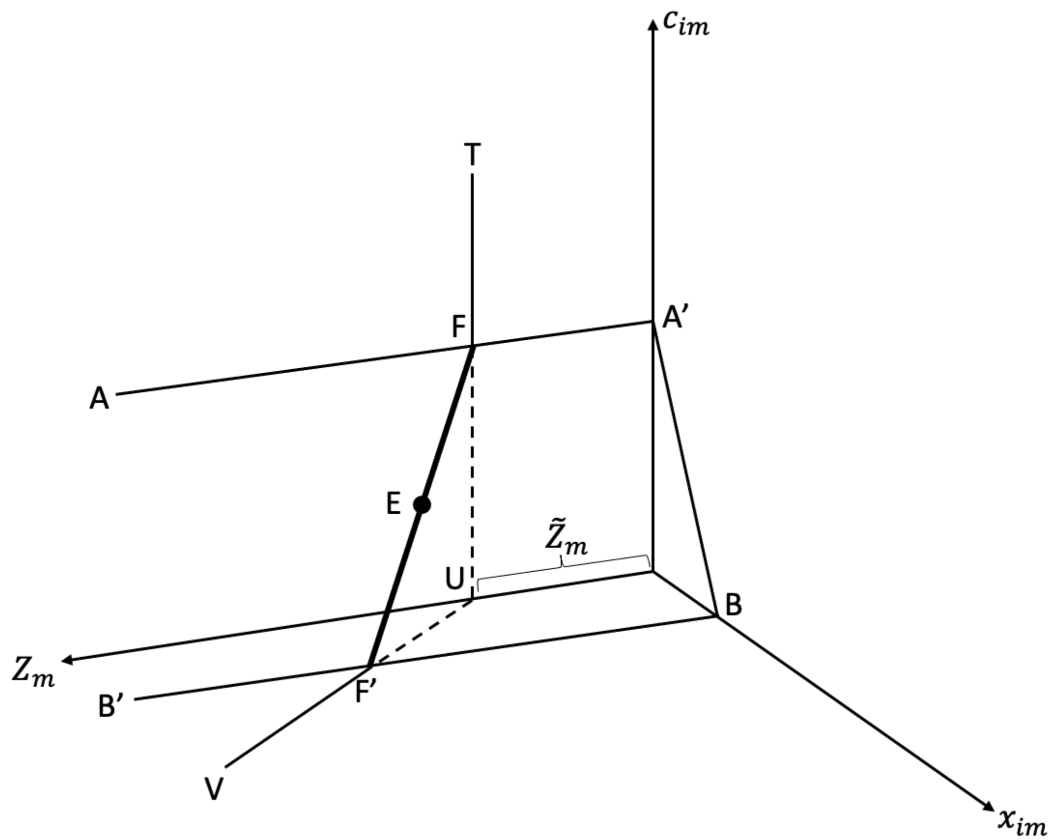
$$I_{im} = c_{im} + x_{im}\frac{p}{\beta} \tag{5}$$

The individuals utility maximization problem can be summarized as:

$$\begin{aligned} \max_{(c,x,z)} \quad & u(c_{im}, x_{im}, Z_m) \\ \text{s.t.} \quad & I_{im} = c_{im} + x_{im}\frac{p}{\beta} \\ & \beta\widetilde{Z}_m = \beta Z_m - \gamma x_{im} \end{aligned} \tag{6}$$

This is a utility-maximizing problem with three choice variables and two linear constraints. Because this is a somewhat unusual optimization problem, figure 1 presents the two constraints in characteristics space. The budget constraint in (5) is represented by the plane AA'BB'. The hyperplane TUV represents the second constraint. The solution to the individual's optimization problem will lie at a point of the two constraints intersection, represented by the line FF'. For simplicity, the indifference curves are not drawn but suppose that they are tangent to the line FF' at the point E. Hence, point E represents the optimal allocation.

Figure 1. *Constraints in characteristics space*



Notes: The figure shows the consumers choice problem in characteristics space. x_{im} is the private characteristic of theater consumpton and Z_m is the public. The composite numeraire private good is represented by c_{im}. The budget constraint is the plane AA'BB' and the plane TUV represent the quantity constraint. Point E represent the optimal allocation. Indifference curves are not shown. Own illustration based on **cornes1996theory**.

The langrangian for the individuals problem is:

$$L = u(c_{im}, x_{im}, Z_m) - \lambda_1[c_{im} + x_{im}\frac{p}{\beta} - I_{im}] - \lambda_2[\beta Z_m - \gamma x_{im} - \beta \widetilde{Z}_m] \tag{7}$$

with the following first-order conditions:

$$\begin{aligned} &\frac{\partial u(\cdot)}{\partial c_{im}} - \lambda_1 = 0 \\ &\frac{\partial u(\cdot)}{\partial x_{im}} - \lambda_1 \frac{p}{\beta} + \lambda_2 \gamma = 0 \\ &\frac{\partial u(\cdot)}{\partial Z_m} - \lambda_2 \beta = 0 \end{aligned} \tag{8}$$

$$\lambda_1 = \frac{\partial u(\cdot)}{\partial c_{im}},\ \lambda_2 = \frac{1}{\beta}\frac{\partial u(\cdot)}{\partial Z_m}$$

It then follows that for any given value of $\widetilde{Z}_m$ an optimum implies that:

$$MRS_{qc} = p = \beta \frac{\frac{\partial u(\cdot)}{\partial x_{im}}}{\frac{\partial u(\cdot)}{\partial c_{im}}} + \gamma \frac{\frac{\partial u(\cdot)}{\partial Z_m}}{\frac{\partial u(\cdot)}{\partial c_{im}}} = \beta \psi_{xc}(\cdot) + \gamma \psi_{Zc}(\cdot)$$

This result says that the MRS between the two marketed goods equals a weighted sum of the characteristics MRS, ψ_{xc} and ψ_{Zc}. These latter terms can be interpreted as the implicit prices of the characteristics or as *uncompensated inverse demand functions* which traces out how much the individual is willing to pay for an extra unit of one of the characteristics. Formally, they are defined as:

$$\psi_{kc} = \psi_{kc}(p, I_{im}, \widetilde{Z}_m, \beta, \gamma),\ \forall k \in \{x, Z\} \tag{9}$$

the inverse demand functions depends on the observed parameters of the choice problem. Hence, in the quasi-public goods model, an individuals valuation, or benefit, depends on the price of theater tickets, p, the level of other individuals' contributions towards the public good $\widetilde{Z}_m$, the individual's income I_{im} and the relative magnitudes β and γ. Changing one of these parameters causes a change in one or both of the constraints and, consequently, the individual's optimal allocation. In this paper, the primary interest centers on the inverse demand function $\psi_{Zc}(\cdot)$. This is what we intend to estimate empirically.

2.3 The effects of a change in community consumption

In this section, we derive and present the theoretical prediction of how individuals' valuation is affected by a change in the rest of the community's consumption. We refer to this change as the external return. This change acts as an imposed quantity change on the individual's consumption of the public good. Notice that this welfare effect is somewhat unusual. Typically, we are not treating the quantity as exogenous but rather endogenous as a function of price. This is the traditional demand system. In this paper, we are interested in working with the dual to this system, the inverse demand system. In this system, prices, or rather valuations, are treated as a function of quantity, which is, at the aggregate level, assumed exogenous to the individual. The differences between these two systems are subtle, and we explain any differences in the derivations below.

We depart from the observation that the dual approach to the consumer's problem is to minimize expenditures:

$$E(p, \widetilde{Z}_m, \beta, \gamma, u_{im}) = \min_{(c,x,z)} \{c_{im} + x_{im}\frac{p}{\beta} \mid u(c_{im}, x_{im}, Z_m) \geq \bar{u},\ \beta \widetilde{Z}_m = \beta Z_m - \gamma x_{im}\} \tag{10}$$

Where $\bar{u}$ is a fixed utility level that is achieved by minimizing quantities at prevailing prices. Assume that $\bar{u}$ denotes the equilibrium utility level obtained from the primary approach of the individual's problem. The Jacobian of (10) contains the standard compensated demand functions. The dual to the expenditure function is the *distance function* (See, e.g., Anderson, 1980, Deaton, 1979, 1981 and Deaton and Muellbauer, 1980). It may be expressed as:

$$D(c_{im}, x_{im}, Z_m, u_{im}) = \max_{\delta} \left\{ u\left(\frac{c_{im}, x_{im}, Z_m}{\delta}\right) \geq \bar{u} \right\} \tag{11}$$

That is, for a given quantity and a given level of utility, $D(\cdot)$ is the amount by which the quantity must be scaled such that the scaled bundle $\frac{c_{im}, x_{im}, Z_m}{\delta}$ yields utility level $\bar{u}$. It is possible to rewrite (11) as a function of the model parameters by exploiting its relation to the expenditure function. We provide the mathematical details in appendix A1. Therefore, we rewrite the distance function to:

$$D(p, \widetilde{Z}_m, \beta, \gamma, u_{im}) = \min_{p} \left\{ c_{im} + x_{im}\frac{p}{\beta} \mid E(\cdot) = 1,\ \beta\widetilde{Z}_m = \beta Z_m - \gamma x_{im} \right\} \tag{12}$$

Applying Shepard's lemma yields the Jacobian to (12) which defines the *compensated inverse demand functions*. Unlike the uncompensated inverse demand functions we derived in (9), the compensated counterparts are defined as functions of utility and quantity supplied. Formally, we define the compensated demand functions as:

$$\frac{\partial D(\cdot)}{\partial \theta} = \zeta_\theta(p, \widetilde{Z}_m, \beta, \gamma, u) \tag{13}$$

where $\theta \equiv c, x, Z$ is shorthand for any of the quantities in $D(\cdot)$. Armed with this result it must hold in any equilibrium that:

$$\begin{gathered} \frac{\frac{\partial u(\cdot)}{\partial k_{im}}}{\frac{\partial u(\cdot)}{\partial c_{im}}} = \frac{\frac{\partial D(\cdot)}{\partial k_{im}}}{\frac{\partial D(\cdot)}{\partial c_{im}}} \\ \Rightarrow \psi_{kc}(p, \widetilde{Z}_m, \beta, \gamma, I_{im}) = \zeta_{kc}(p, \widetilde{Z}_m, \beta, \gamma, u),\ \forall k \in \{x, Z\} \end{gathered} \tag{14}$$

These functions are simply alternative ways of defining the same magnitudes and must be equal in any optimum both before and after a change in $\widetilde{Z}_m$. The last step, before we can derive the external effect is to substitute direct demand $u(\cdot)$ with the indirect utility, which expresses the individuals maximum utility as a function of the parameters that define the constraints. Hence, indirect utility is defined as $V(p, \widetilde{Z}_m, \beta, \gamma, I) \equiv \max_{c,x,z}\{u(c, x, Z) \mid c + x\frac{p}{\beta} = I,\ \beta\widetilde{Z}_m = \beta Z_m - \gamma x\}$. Partial differentiating (14) for the public characteristic with respect to a change in $\widetilde{Z}_m$ yields an analogue of the Slutsky equation for inverse demand:

$$\frac{\partial \psi_{Zc}(\cdot)}{\partial \widetilde{Z}_m} = \frac{\partial \zeta_{Zc}(\cdot)}{\partial \widetilde{Z}_m} + \frac{\partial \zeta_{Zc}(\cdot)}{\partial V(\cdot)}\frac{\partial V(\cdot)}{\partial \widetilde{Z}_m} \tag{15}$$

With uncompensated *direct* demand, any change in the marginal rate of substitution can be decomposed into an income and substitution effect, which can be represented using the Slutsky decomposition. Compensation is ensured by a change in income or a proportional change in prices. Although (15) is a resemblance to the direct approach, a proportional change in quantities ensures the compensation. Hence, the response is not equivalent to an income and substitution effect. Furthermore, the interpretation and sign of the two terms appearing on the right-hand side are not trivial.

Deaton, 1981 suggest that the first term may be either positive or negative depending on whether z_{im} and $\widetilde{Z}_m$ are quantity complements or quantity substitutes. If they are complements, an increase in $\widetilde{Z}_m$, at constant utility, will increase the marginal valuation of z_{im} at the expense of a lower valuation of the composite good, c_{im}. Thus, the first term will be positive. On the other hand, If they are substitutes, the marginal valuation will fall, and the term will be negative because the individual values other goods higher at constant utility.

The last term on the right-hand side of (15) can also be given a sensible interpretation. When $\widetilde{Z}_m$ is increased marginally, it implies that the quantity restriction imposed on individuals also increases. Graphically this is equivalent to a shift outwards in the second restriction in figure 1[3]. They can now consume more of the external benefits generated by others at a price of zero. This does not affect the consumer's consumption choice between the composite good and theater tickets because income and prices are unchanged. However, they can obtain a higher level of utility from their optimal bundle. The last term is then positive if the valuation of the public good increases when the individual becomes better off. Intuitively it seems reasonable to assume that the last term is positive[4]. However, the sign of the total effect cannot be established theoretically because the first sign can be either positive or negative.

3 Econometric framework

Equation (9) provides the theoretical basis for the empirical work and is the relationship of interest. The public characteristic, $\widetilde{Z}_m$, is unobserved by us. However, we can recover it using the technological conditions that transform the marketed good into characteristics. Specifically, recall that $z_{im} = \gamma q_{im}$ which implies that $\widetilde{Z}_m = Z_m - z_{im}$ is equivalent to $\gamma\widetilde{Q}_m = \gamma(Q_m - q_{im})$. We choose to include $\widetilde{Q}_m$ as log-transformed in the model. Henceforth, we refer to $\widetilde{Q}_m$ as the *log of total visits* or *aggregate demand*. Though, note that it is, in fact, a leave-one-out aggregate measure. The parameter β enters through the condition for the private characteristic, $x_{im} = \beta q_{im}$. In practice, there may be a host of other factors that may influence individuals' valuation besides the parameters embodied in the inverse demand functions. An error term is therefore added to the estimation equation. Also, note that the model has a clear group structure. Individuals reside in municipalities, and the regressor of interest, $\widetilde{Q}_m$, varies only at the municipal level. As a result, we assume an intraclass correlation within municipalities, and we account for this by assuming that the residual has a group structure. Lastly, we assume that the functional form is linear and additive. Estimation can therefore be based on the following structural equation for individual i residing in community m:

$$Y_{im} = \alpha_0 + \gamma\widetilde{Q}_m + \beta q_{im} + \alpha_1 I_{im} + \alpha_2 p_{im} + \nu_m + \eta_{im} \tag{16}$$

Where Y_{im} is individual i's valuation of the public good element of theaters in community m. ν_m is a random component specific to community m and η_{im} is an individual-level error component. The parameter β captures the private return to individual consumption, and the parameter γ captures the external return to theaters. Later in the paper, we add additional covariates to the structural model as outlined in section 4.2.

The model proposed in (16) defines a structural relationship based on theoretical assumptions,

[3]In the figure, this corresponds to a shift in the hyperplane TUV, but the plane AA'BB' is unchanged.
[4]However, the last term can be negative if the individual regards theaters as a public bad.

but it is not necessarily a causal relationship. There are several identification problems raised by (16). The central problem with estimating the external returns within municipalities is that the cross-sectional variation in theater consumption is generated by selection. Theater visits are not randomly assigned within and across municipalities. Instead, individuals make their own choice of theater visits. In turn, this implies that there may be omitted variable bias from a potential correlation between aggregate demand and other community effects embodied in the error term, ν_m. There may be several reasons for this omitted variable bias. For example, the quality of the theaters in the community may potentially confound the relationship. Quality is to be understood broadly. It naturally refers to a theater's production value, its ensemble of actors, the venue, repertoire, and characteristics. Whether or not the local theater in a given community is of historical and aesthetic value or renowned for its performances. While it is true that public funding for a specific theater requires a certain level of artistic quality verified by funding agencies, there is no reason to believe that communities' quality of supply is homogeneous because the same organization has verified them. Each theater is unique, and therefore it seems most reasonable to assume that quality varies accordingly among them.

A second-order problem of quality variations is its potential effect on consumer uncertainty. Uncertainty is likely present when quality is heterogeneously distributed, and each performance is unique. In such cases, a potential consumer may seek to mitigate the uncertainty by referring to the judgments provided by experts. However, this imposes an implicit transaction cost because it often involves searching for information. For example, a consumer may read reviews from experts, obtain information through hearsay from previous spectators, or by relying on past information to ascertain the reputation of the actors, playwrights, or theater companies. In short, consumption may be, among other things, a function of information. However, information aggregation is naturally constrained by the *critical mass* of experts within the community. Likely, this varies considerably among communities and is most probably skewed towards metropolises with a large and varied supply of theaters[5].

There are at least two more reasons, besides the *quality bias*, that may confound the relationship. First, theater consumption is often a joint decision. Seldom do individuals visit a theater on their own. Rather, it is often a social activity carried out as a group. To put matters into perspective, only 4 percent report in our sample that they attend theaters in solitude. Individuals often attend with their partners, friends, children, grandchildren, colleagues, or clubs. To see why this is problematic, suppose that an individual is very fond of theaters and, as a result, avidly attends performances. If this individual invites along companions, it implies that some of the community's aggregate demand is caused by the individual's actions and underlying preferences. In addition, if these preferences also cause the valuation of theaters, it is a confounder that needs to be controlled for. The preference bias likely also confounds the relationship between individuals' valuation and private returns. These preferences are both a cause for the number of visits an individual consumes and the valuation put on these. Hence, the private return is therefore *not* identified in (16).

Second, the total number of visits within a municipality is most likely measured with error. Statistics Denmark collects visitor data through a voluntary survey administered to the individual theaters. The season 2019/2020 was affected by shutdowns due to the Covid-19 pandemic, and some theaters had limited resources to report the required data. Therefore, the visitor data has to some extent, been

[5]Indeed, out of 548 theater reviews published in newspapers since the year 2000, roughly three-quarters of them have been published in one of the five most populous municipalities. See the Royal Danish Library's digital media collections of newspapers.

imputed and validated in the official statistic. We add to this problem by using a constructed measure by weighting the aggregated number of visits as described in section 4.1. Measurement error implies that the parameter $\hat{\gamma}$ will be biased towards zero (see e.g. Wooldridge, 2010). Hence, if γ is positive (negative) $\hat{\gamma}$ will tend to underestimate (overestimate) γ on average.

4 Data and OLS Estimates

This section introduces the data used in this paper and provides relevant background information for how we have elicited individuals' valuation of theaters.

4.1 The sample

We merge data from several administrative registers - the income register, the population register, and the educational register - with a Contingent Valuation (CV) survey administered by Statistics Denmark in the first half of 2020. The survey was sent to a sample of 4,450 representative Danes. 2,003 answered the survey, which is equivalent to a response rate of 45 percent. Starting from the sample of individuals who completed the survey, we impose some restrictions to obtain our primary dataset. This leaves us with a valid sample of 1,231 observations[6].

We designed the survey following current best practices for CV studies (Johnston et al., 2017). This includes cheap talk, which continuously informs respondents that they should adhere to their budget restrictions and that the valuation they place on the good could have been spent on other public purposes or private consumption. We also tested the survey in several focus groups to ensure that respondents understood the questions correctly.

We are interested in estimating an elasticity and therefore transform the valuation responses. However, the distribution of the variable is zero-inflated, and the natural log cannot handle such values. Thus, we would discard a large number of observations by doing so. One solution would be to log-transform the variable with zero values replaced for ones. Nevertheless, this can have unintended consequences for the resulting estimates (Bellemare and Wichman, 2020). Therefore, we choose to approximate the natural log using an *inverse hyperbolic sine* transformation[7]. This transformation can handle zero values, and the interpretation of the estimates are equivalent to a log transformation[8].

Visitor data is unfortunately not available for each theater or municipality. Only an aggregate national measure is available. Therefore, we have constructed a measure for each municipality's total number of visits. To do so, we have used Statistics Denmark's quarterly *Cultural Habits Survey*. This survey is sent to a representative sample of the Danish population and contains information on respondents' number of theater visits and microdata for each. In addition, we ask each respondent about their theater habits in the last 12 months in our survey. As a result, there is an overlap with our sample for the quarters 2019Q3 to 2020Q2. We used these periods to derive the number of visits in each municipality and its share of the total visits across municipalities. This share is then used to

[6] The survey questions can be reviewed in appendix A2.

[7] Formally, $\operatorname{arsinh} Y_{im} = ln\left(Y_{im} + \sqrt{Y_{im}^2 + 1}\right)$. Where Y_{im} represents individual i living in municipality m valuation of theaters.

[8] In results not reported we find that the results are robust to these different transformations and do not change our conclusions.

weigh the aggregate measure found in the official statistic. Importantly, municipalities' shares of the total number of visits are relatively constant across periods.

The price of theater tickets enters individuals' budget constraints and, consequently, the valuation as outlined in section 2.2. Implicitly, the theoretical model assumes that only one price exists, but in reality, there exist several. Theaters actively use nonlinear pricing and price differentiation. For example, a seat on the parquet is more expensive than one on the balcony. Furthermore, we do not know what performances the respondents have seen, what type of ticket they bought, or where they sat. We only know how many performances they have attended. To circumvent these issues, we proxy the price of theater performances by how much they state to have spent within the last twelve months on these.

4.2 Summary statistics

Table 1 present summary statistics for the samples used in the analysis. Since the full sample is representative of the Danish population, we can use it as a benchmark to assess whether or not the other sample generalizes to this. The analysis departs with the valid sample, which includes data on valuations and socioeconomics. We divide the valid sample into two sub-samples. One for individuals who have attended a theater within twelve months at the time of the survey, the users, and those who have not, the non-users. These samples were chosen because these two groups might differ in terms of their perceived external benefits of theaters. Theatergoers may be have more extensive knowledge about and appreciation of the social benefits a theater might provide compared to those who do not use them. If so, we would expect that the two groups differ in terms of their perceived external returns.

We have divided the variables into three different groups. These groups will be used in various specifications in section 4.3 and 6. First, the structural covariates are those variables that directly enter the theoretical relationship in (9)[9]. We also control for individuals sociodemographic background such as the respondents years of education, age, sex, the number of children living at home and their immigration status. Lastly, comparing across municipalities is problematic as they are qualitatively different. The individual municipalities have different politics, geographies, roles and importance. Hence, we include coviates to control for these elements.

Table 1 shows that the average valuation, or perceived benefit, of theaters differ across samples, where users are willing to pay more than non-users. Users also tend to earn more than their counterparts and also more than the average income in Denmark. The mean years of education is 12.56 in the representative sample. Theatergoers tend to be more well-educated with 13.09 years of education and non-users are slightly less well-educated. Moreover, users are older, tend to be females and are more likely to be married. The older age of individuals in the valid sample may also explain why there is a lower share of children living at home. Moreover, less theatergoers are immigrants, which might be attributable to language barriers. Lastly, users tend to live in more populous municipalities that have more theaters. This fact is likely a result of more users living in the capital region of Denmark and also explains why users live in municipalities that spend more on theaters.

[9]In theory, the individual number of theater visits does not explicitly enter the function. Though, when we cast the model in quantity space, it does. We outline this in the next section.

Table 1. *Descriptive statistics*

		Samples		
	Full	Valid	Users	Non-user
(a) Dependent variable				
Arcsinh valuation	3.91	3.96	4.97	3.14
	(2.976)	(2.976)	(2.633)	(2.989)
(b) Structural covariates				
Log of total visits	9.7	9.68	9.89	9.52
	(1.113)	(1.108)	(1.138)	(1.054)
No. visits	0.94	2.17	4.8	0.0
	(2.405)	(3.395)	(3.587)	(0.000)
Log of income	12.14	12.44	12.6	12.31
	(2.817)	(2.010)	(1.664)	(2.247)
12 month spend on tickets	299.32	716.43	1586.19	0.0
	(918.204)	(1341.806)	(1614.951)	(0.000)
(c) Individual covariates				
Years of education	12.56	13.03	13.69	12.48
	(2.826)	(2.790)	(2.741)	(2.712)
Married	0.44	0.54	0.57	0.52
	(0.497)	(0.498)	(0.495)	(0.500)
Age	49.45	52.29	52.45	52.16
	(19.236)	(17.770)	(17.208)	(18.231)
Female	0.51	0.51	0.58	0.45
	(0.500)	(0.500)	(0.494)	(0.497)
Children living at home	0.36	0.33	0.3	0.35
	(0.481)	(0.469)	(0.460)	(0.476)
Immigrant	0.15	0.07	0.06	0.08
	(0.354)	(0.260)	(0.243)	(0.274)
(d) Municipality covariates				
Log of inhabitants	11.38	11.37	11.52	11.24
	(0.964)	(0.962)	(1.006)	(0.907)
Dummy for proximity to theater	0.87	0.87	0.9	0.84
	(0.337)	(0.336)	(0.296)	(0.363)
Dummy for educational supply	0.64	0.64	0.66	0.62
	(0.479)	(0.481)	(0.475)	(0.486)
North Denmark Region	0.11	0.1	0.07	0.12
	(0.310)	(0.296)	(0.256)	(0.323)
Central Denmark Region	0.23	0.23	0.21	0.25
	(0.418)	(0.422)	(0.405)	(0.435)
Region of Southern Denmark	0.21	0.22	0.21	0.22
	(0.409)	(0.412)	(0.407)	(0.416)
Capital Region of Denmark	0.31	0.3	0.38	0.24
	(0.461)	(0.459)	(0.485)	(0.427)
Region Zealand	0.15	0.15	0.14	0.17
	(0.356)	(0.360)	(0.344)	(0.372)
Log of public cultural funding	11.52	11.42	12.06	10.89
	(6.967)	(7.045)	(6.843)	(7.169)
N	4,450	1,231	556	675

Notes: This table presents the means and standard deviations of key variables in the full sample and for the sample who have provided a valuation response. The total number of visits is constructed based on data provided by Statistics Denmarks cultural habits survey. We use a measure for full income without wealth and pension contributions. The 12 month spend on theater tickets and the total number of individual visits are reported by the individuals. Years of education are based on the highest completed education and top coded at 21 years. An individual has children living at home if they are below 25 years of age and live in the same household. An individual is an immigrant if they are born outside Denmark and none of the parents are Danish citizens. The theater dummy equals one if the municipality has a publicly funded theater. The higher education dummy equals one if the municipality has an educational institution at a higher level than high school.

4.3 OLS Estimates

Table 2 shows that OLS estimates of external returns differ across groups, and are relatively robust to the inclusion of structural and individual covariates. Though, controlling for municipality covariates change all of the results markedly. The covariates included correspond to those reported in table 1. All standard errors reported have been corrected for municipality clustering because of the group structure discussed earlier.

The OLS estimates for the valid sample in model (4), which controls for all covariates imply that a one-percentage increase in the number of theatergoers is associated with a 0.418 percentage point increase in the perceived benefits of theaters of all individuals within that community. Hence, individuals who consume art is associated with an increase in their citizens welfare as would be expected if positive externalities are present. However, the estimate is not significantly different from zero on average, which imply that we cannot reject the hypothesis of no externalities. Using only data for the sub-sample of theatergoers the estimate in model (4) is 0.992 and significant at a five percent level. Whereas, the non-user sample leads to an estimate of external returns of -0.065 and insignificant.

Interestingly, the external return estimates differ between theatergoers and non-users controlling for structural-, individual-, and community covariates. Moreover, this may also explain why the effect is smaller and insignificant on average. However, these estimates may be biased by omitted variables. The remainder of the paper presents evidence on whether the association between community arts consumption and perceived benefit reflects arts-consumption externalities.

Table 2. *OLS Estimates of the external returns to theaters*

	(1)	(2)	(3)	(4)
(a) Valid sample				
External returns to theaters	0.389***	0.261***	0.203**	0.418
	(0.074)	(0.069)	(0.081)	(0.312)
(b) Users sample				
External returns to theaters	0.341***	0.309***	0.301***	0.992**
	(0.080)	(0.082)	(0.094)	(0.428)
(c) Non-users sample				
External returns of theaters	0.182*	0.181*	0.107	-0.065
	(0.108)	(0.108)	(0.125)	(0.386)
Structural covariates		✓	✓	✓
Individual covariates			✓	✓
Municipality covariates				✓

Standard errors corrected for municipality clustering are reported in parentheses.
$^*p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

5 Share of Discount Eligible and Community Consumption

In this section, we outline the required assumptions that give (16) a causal interpretation. First, we introduce and provide background information on the national ticket purchasing scheme and our proposed instrument. Second, we list and discuss the assumptions required before our instrument unconfounds the relationship of interest. Lastly, given these assumptions, we present the instrumental variable estimator in our context and shed light on for whom our IV estimates measure the external returns.

5.1 Background on the ticket purchasing scheme

The ticket purchasing scheme has its legal basis in the Danish Performing Arts law. The scheme is national and administered by the Ministry of Culture. The primary purpose is to decrease the price of theater tickets for individuals below 25 years of age. In practice, it is the individual theaters that set the discount. However, the discount is regulated. It should be a minimum of DKr 30 per ticket, and the minimum price of a ticket with a discount should be DKr 32. Data provided by the largest online theater ticket booth shows that the average discount is roughly DKr 350 per ticket[10]. This number is calculated from performances without free entrance and with a discount for individuals below 25 years of age. On average, the price for discounted tickets is close to 40 percent lower than the regular ticket price. Within these regulatory boundaries, the theater is free to set the discount. The difference between the actual price of the ticket and a discounted ticket is reimbursed by the government as a subsidy. Crucially, theaters that receive public funding are entitled to the subsidy without applying for it. The publicly funded theaters are also the population we are studying in the current paper, and the individual's valuation of theaters is also based on this population.

5.2 Is the share of discount-eligible a legitimate instrument?

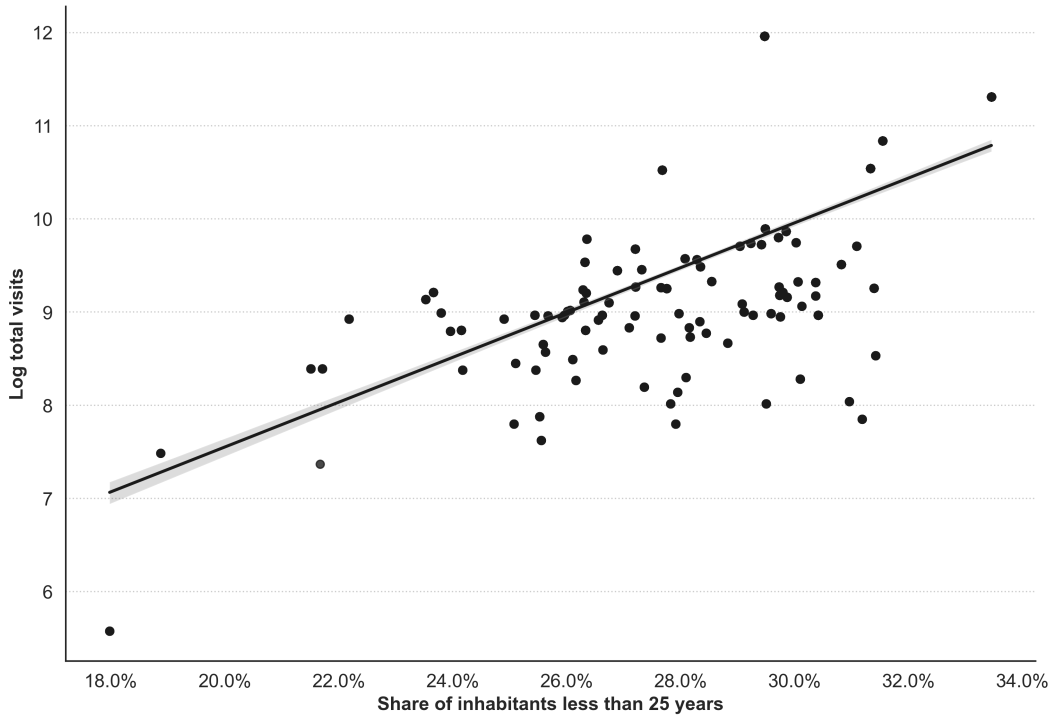
Because the ticket purchasing scheme assigns eligible individuals to a different price than others, municipalities' share of eligible should be expected to influence the total number of theater visits. This relationship would be expected because the discount causes a movement along current theatergoers' demand curve and an extensive response from others. Some might go to the theater regardless of the discount, but the quantity demand is higher with it. Others who would not have gone to a theater may be compelled to do so because they are eligible for a discount. These facts produce a correlation between the share of individuals below 25 years of age within a municipality and the total number of theater visits. Consequently, we should expect municipalities with a younger age distribution, or a larger share of eligible individuals, to have a higher level of total visits compared to those with an older age distribution.

To check this basic insight, we fit a simple linear model of the share of eligible individuals to the log of total visits within each municipality. Figure 2 document this relationship along with the line of best fit. The figure shows, as expected, a positive relationship between the fraction of eligible individuals and the total number of visits within municipalities. A one percentage point increase in the fraction of eligible increases the total number of visits by 0.34 percent on average. The relationship seems to be most pronounced in the distribution's tails, with more variation in the center. However, on average, the trend is increasing which is consistent with the notion that a larger share of discount-eligible individuals cause higher community consumption.

The variable indicating the fraction of eligible individuals is not discrete, complicating the interpretation of the IV estimates and the evaluation of the instrumental variable. We therefore recode

[10]The data is provided by *Scenit* based on the central theater registry database *Tereba*. The dataset covers the 2020/2021 season and includes all publicly listed performances.

Figure 2. *The relationship between the share of discount-eligible individuals within municipalities and log total visits.*



Notes: The figure shows the relationship between the share of discount-eligible individuals relative to the total population within municipalities and log of total visits. An individual is eligible for a discount on their theater tickets if they are below 25 years of age. Each dot represents one of the 98 municipalities in Denmark.

the continuous fraction of eligible individuals into deciles, Φ_l for $l \in \{1, 2, ..., 10\}$. Hence, each municipality is assigned, say, one if their fraction belongs to the first decile in the distribution and so on. Later on, we are going to be working with a set of ten instruments, each representing a dummy variable for the deciles, i.e., $d_l = 1(\Phi_l)$. We want to work with a set of ten instruments because the local average causal response applies to a more representative group than in the one instrument case. We outline and discuss this below. However, without loss of generality and for the sake of clarity, we proceed with the case where d_l takes on only two values, 0 and 1, indicating the first decile and the second to tenth deciles. We can do so because the IV estimator is just a weighted average of all the instrument-specific effects using one instrument at a time (Angrist and Pischke, 2009).

Having redefined the proposed instrument, we now turn to the required assumption that makes them valid. First, note that the inverse demand functions presented in (9) are, in fact, a representation of an individual's potential outcomes. It tells us how much individual i living in the community m value the public good characteristics of theaters for any value of aggregate demand and covariates. The current specification does not explicitly incorporate the instruments, but we can do so with a slight abuse of notation. Specifically, suppose that each individual i would value theaters ψ_{ims} if he or she lived in a community m with aggregate demand of s. Furthermore, define $\widetilde{Q}_{md_l} \in \{0, 1, 2, ..., s\}$ to be the number of tickets bought within a community conditional on what part of the age distribution their decile of eligible belongs to, d_l. Hence, $\widetilde{Q}_{m1}$ is the total number of visits within a municipality if their share of eligible belonged to the 2nd to 10th decile, and $\widetilde{Q}_{m0}$ is the total number of visits if it belonged to the first decile. Our principal identifying assumption is then:

Assumption 1,Independence and Exclusion. The potential outcomes, $\psi_{im0}, \psi_{im1}, ..., \psi_{ims}$ and $\widetilde{Q}_{m1}, \widetilde{Q}_{m0}$ are jointly independent of the instrument, d_l. Conditional on the controls included in the regression, the share of eligible within a municipality does not affect individuals' valuation of theaters other than through variations in the total number of visits. Alternatively, it can also be stated that the instruments are uncorrelated with the first-stage and reduced form error terms. This is a strong assumption and therefore deserves a discussion in the current context.

First, the share of individuals below 25 years of age within a community is not random. It is likely caused by migration, among other things. For instance, some may choose to live in larger and more populous communities, while others choose smaller and less inhabited. In contrast, the population size is likely also a cause for the aggregate demand within municipalities. With more inhabitants, there likely is a higher share of theatergoers among them.

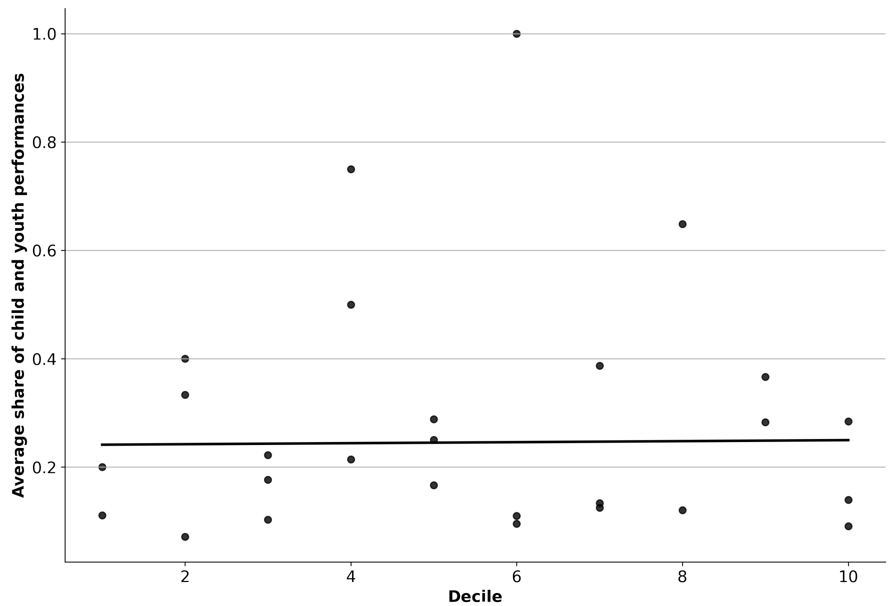
Similarly, the availability of education may also be a cause for migration. For instance, the municipalities whose age distribution belongs to the ninth and tenth decile also tend to have a high education supply. Moreover, a higher level of educational supply interacts with the general educational level, and a common finding is that cultural demand is highly related to years of education (Snowball, 2007). In this light, we argue that controlling for communities' population size, supply of education, and region-specific effects, the instruments are *as good as random*.

Apart from concerns over the independence assumption, there is also the possibility that the implied exclusion restriction is not satisfied. A higher share of young individuals may affect the type of theater supply, which may alter individuals perceived benefit and, ultimately, their valuation of the theaters. While we cannot rule this out entirely, we can try to falsify it. If the claim is true, we should expect to find a positive relationship between the share of eligible and the fraction of total theater performances whose main audience is children or young individuals. Figure 3 plots the relationship using data on 1400 performances. The dataset contains information on the type of performance and target audience annotated by the theaters themselves[11]. The figure shows no relationship between deciles of young individuals and average shares of child and youth performances. We take this as evidence that more young individuals in a community do not affect the type of theater supply.

There are potentially two other concerns regarding the exclusion restriction. First, current theatergoers may prefer attending performances with others who are "like themselves". That individual's networks are homogeneous concerning many sociodemographic, behavioral, and personal characteristics is a well-known fact and are known as the homophily principle (McPherson et al., 2001). So, when the scheme induces some young individuals to attend a theater existing theatergoers may not prefer this. For instance, because these new theatergoers may not know of the unwritten "rules" or existing norms. Nevertheless, for a larger share of younger theatergoers to affect individual preferences, it must be the case that regular attenders can predict the composition in advance. We find it unlikely that theatergoers choose not to buy a ticket or reschedule because they believe that many young individuals will attend. This would require knowledge that is not known at the time when the purchasing decision

[11] The data is provided by *Scenit* based on the central theater registry database *Tereba*.

Figure 3. *Share of discount-eligible in deciles and the average share of child and youth performances within municipalities*



Notes: The figure shows the relationship between the share of discount-eligible in deciles and the average share of child and youth performances. Each dot corresponds to a municipality in Denmark. The total number of performances is 1400 in 50 unique municipalities. The data is provided by *Scenit* based on the central theater registry database *Tereba*. The dataset covers the 2020/2021 season and includes data for 1400 performances.

takes place.

Another potential criticism of the exclusion restriction is that the share of young individuals is directly related to the bequest motive, as we outlined in section 2.1. In this sense, the instrument is a cause of individuals' preferences and their valuation. However, the bequest motive is not related to current generations. Instead, it is only defined for generations not yet born (Greenley et al., 1981). In sum, we believe that our exclusion restriction is plausible, but we also acknowledge that it may fail if, for any reason, the share of young individuals affects individuals' valuation of theaters in other ways than through changes in aggregate demand.

Assumption 2, First Stage. Because the instrument does not affect the individual's valuation, any change must come from an effect of the instrument on the aggregate demand. Therefore, we assume that aggregate demand in municipalities in the first decile ($d_l = 0$) differs from aggregate demand in municipalities in the 2nd to 10th decile ($d_l = 1$).

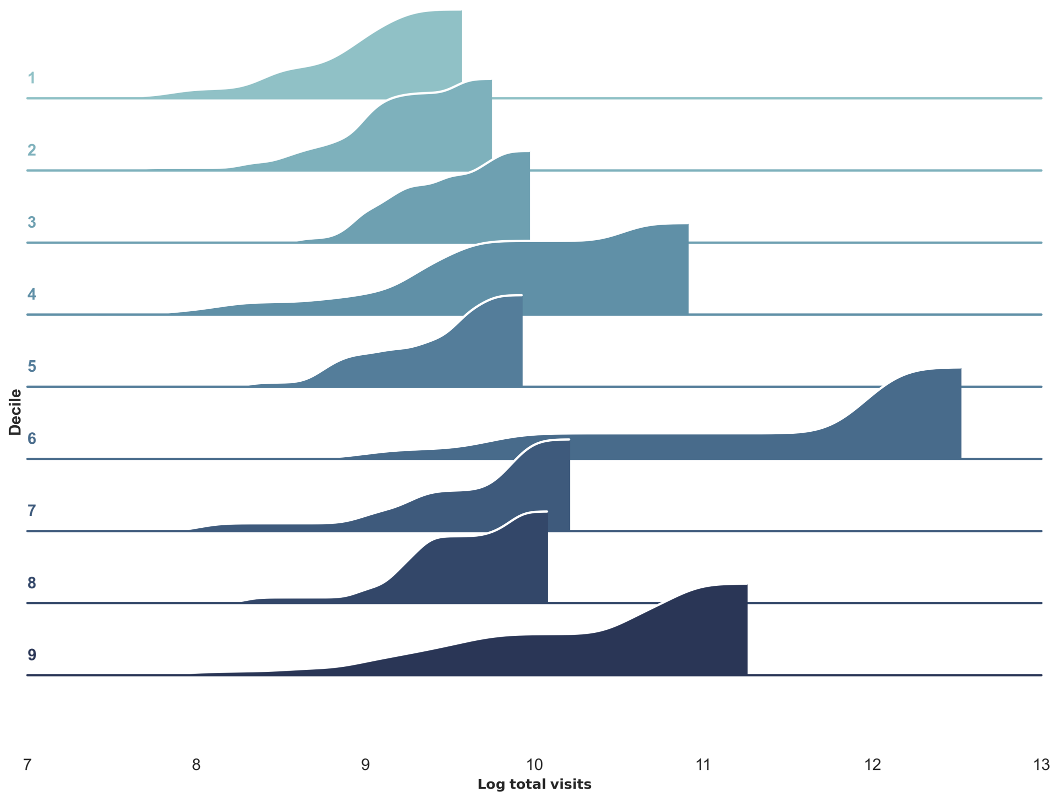
Assumption 3, Monotonicity. We assume that monotonicity is satisfied for the instrument, d_l. Either $\widetilde{Q}_{m1} - \widetilde{Q}_{m0} \geq 0 \, \forall m$ or vice versa. We assume the first case. An implication of this in the current context is that the monotonicity assumption requires that, because of the dissemination scheme, aggregate demand in municipalities whose share of eligible belongs to the second to tenth decile have *at least* as many visitors as they would have had if they belonged to the first decile. That is, we rule out a scenario where aggregate demand in a municipality is high *because* their potential fraction belongs to the first decile. If the latter were the case, it would be equivalent to defiant behavior. In this sense, as fewer individuals are eligible for a discount, the more will choose to attend theater performances. This assumption is not verifiable because it involves unobserved outcomes. But because $\widetilde{Q}_{md_l}$ is multivalued the assumption has testable implications (See e.g. Angrist and Imbens, 1995). Specifically, we can investigate the empirical cumulative distribution functions (CDF) of $\widetilde{Q}_{m1}$ and $\widetilde{Q}_{m0}$. These two CDFs should not cross. If they do, it is a cause for concern and signifies a potential violation of the assumption[12].

As noted previously, we have worked only with one instrument so far. Nevertheless, we estimate our model with nine instruments and use the first decile as a reference. This also implies that each of the nine instruments should live up to the monotonicity assumption. In figure 4 we plot the CDFs of the dummy instruments. Under the monotonicity assumption, none of the distributions can lie above the CDF of the first decile. The figure shows that all of the CDFs for municipalities whose share of eligible belongs to the second to ninth decile lie below the CDF for municipalities in the first decile. This is important evidence in favor of the monotonicity assumption. Note, that we have omitted the tenth decile in the figure as this only includes one municipality. As such, the CDF is not easily viewed in a figure as it jumps from zero to one at the municipality's log total visits. However, we confirm in results not reported that the CDF of the tenth decile is below the first decile[13].

[12]Formally they should not cross because if $\widetilde{Q}_{m1} > \widetilde{Q}_{m0}$ then $Pr(\widetilde{Q}_{m1} \geq s) \geq Pr(\widetilde{Q}_{m0} \geq s)$ $\forall s$. This implies that $Pr(\widetilde{Q}_m \geq s \mid d_l = 1) \geq Pr(\widetilde{Q}_m \geq s \mid d_l = 0)$.

[13]Furthermore, we also present evidence for it in figure 6.

Figure 4. *Total number of visit CDFs by share of discount-eligible in deciles*



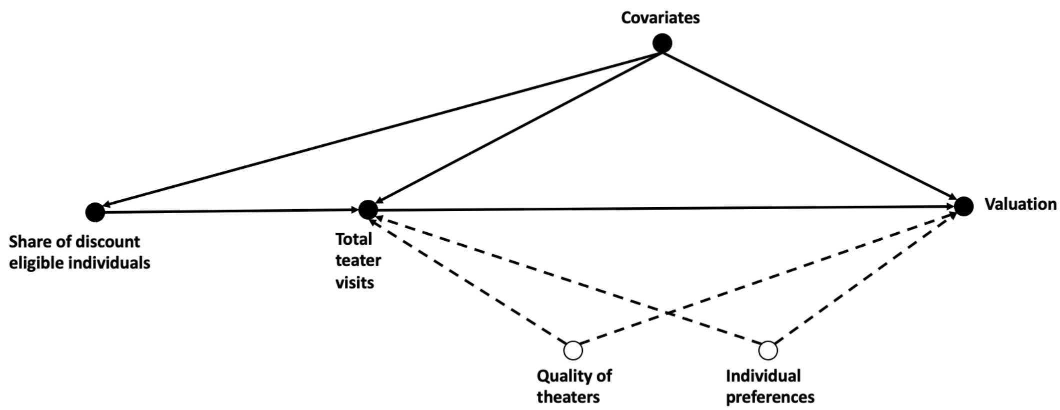
Notes: The figure shows the CDFs of the total number of visits, $\widetilde{Q}_m$, for municipalities whose share of discount-eligible belongs to the first to ninth decile. The tenth decile is omitted for the sake of clarity.

We sum up our discussion of section 3 and our identification strategy in figure 5. The dashed lines indicate that the *quality bias* and *preference bias* are unobserved by us. Furthermore, they confound the relationship of interest as discussed previously. The missing arrows from any of the unobserved nodes to the instrument (share of discount-eligible individuals) and the missing direct arrow from the instrument to the outcome (valuation) represent assumption 1. In addition, the arrows originating from the covariates also show that assumption 1 is conditional on these. These covariates include both structural, individual, and municipality-specific controls and can be reviewed in table 1. The direct arrow from the instrument to total theater visits indicates assumption 2. The monotonicity assumption is not directly represented in the graph. These assumptions combined allow us to give (16) a causal interpretation.

5.3 IV estimates of the external return: for whom?

Given assumptions 1-3, we can derive the IV estimator in our context. If all assumptions are satisfied, the average causal response (ACR) is defined as the ratio of the difference in average valuations at two values of the instrument to the difference in average aggregate demand at the same two values of the

Figure 5. *Causal Diagram for the effect of community consumption on individual valuation*



Notes: A dashed line implies that the variable is unobserved. The missing arrows from any of the unobserved nodes to the instrument and the missing direct arrow from the instrument to the outcome represent assumption 1. The arrows originating from the covariates represent that assumption 1 is conditional on these. The covariates are all of those presented in table 1. The direct arrow from the instrument to total theater visits indicates assumption 2. The monotonicity assumption is not directly represented in the graph.

instruments:

$$\gamma = \frac{E[\psi_{im} \mid d_l = 1, X = x] - E[\psi_{im} \mid d_l = 0, X = x]}{E[\widetilde{Q}_m \mid d_l = 1, X = x] - E[\widetilde{Q}_m \mid d_l = 0, X = x]} \tag{17}$$

which equals a weighted average of the derivate of the inverse demand function with respect to aggregate demand:

$$\gamma = \frac{\int E\left[\frac{\partial \psi_{im}}{\partial \widetilde{Q}_m} \mid \widetilde{Q}_{m1} \geq s \geq \widetilde{Q}_{m0}, X = x\right] Pr\left[\widetilde{Q}_{m1} \geq s \geq \widetilde{Q}_{m0} \mid X = x\right] d\widetilde{Q}}{\int Pr\left[\widetilde{Q}_{m1} \geq s \geq \widetilde{Q}_{m0} \mid X = x\right] d\widetilde{Q}} \tag{18}$$

In other words, the IV estimate using one decile instrument produces an average of the derivate $\frac{\partial \psi_{im}}{\partial \widetilde{Q}_m}$ as derived in equation (15), with weight, $Pr\left[\widetilde{Q}_{m1} \geq s \geq \widetilde{Q}_{m0}\right]$, given to each possible value of aggregate demand, s, in proportion to the instrument-induced change in the CDF of demand at that point. A formal proof for this can be found in Angrist et al., 2000 Theorem 1. With multiple instruments, we add one more layer of weighting and averaging. For each instrument, we estimate an ACR and generate a weighted average of these effects.

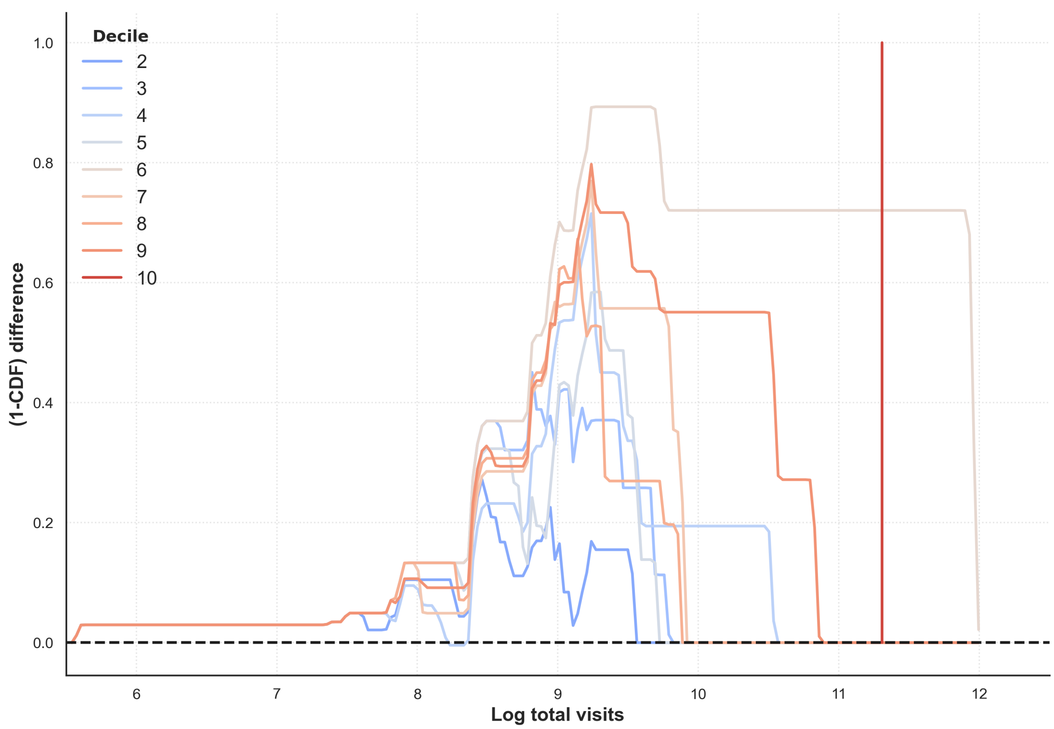
Since the weighting scheme in (18) is proportional to the demand change caused by the instrument, we can use this insight to understand what part of the population our estimate applies to. In figure 6 we plot these CDF differences with the reference group being the first decile. The figure shows that our decile instruments estimate a weighted average of the inverse demand function with the most weight attached to municipalities with aggregate demand between 3,700 and 31,000 visitors, on average[14]. The point with the most weight attached, on average, is aggregate demand of around 8,900 visitors ($e^{9.093}$). If we exclude the reference group of 18 municipalities, the average number of visitors across municipalities is roughly 13.000. Furthermore, the weighting scheme implies that our instruments apply to 65 municipalities in Denmark out of 80, not including the reference group. However, the estimates are of little value in the 15 municipalities with less than 3.700 or more than 31.000 visitors because relatively little weight is assigned to these. Most importantly, this implies that

[14]This corresponds to log total visit of 8.22 - 10.35, the average of the CDF coverages.

our IV estimates assign a low weight, on average, to some of the largest municipalities, Copenhagen, Aarhus, and Odense.

Table 3 quantifies the CDF differences in figure 6. The table reports decile coefficients from regressions on discrete levels of log total visits. The dummies equal one if the log total visits are at or exceed the specified level. The first column reports estimates for the probability that the total number of visits is equal to or higher than 1,100 (log(7)). All of these estimates are equivalent and insignificant. This is also the pattern the figures highlight at this point. Almost all estimates are positive and significant for log total visits 8 to 9 as expected. The probability that the number of visits exceeds log(10) is positive for the fourth, sixth, and ninth decile. However, the estimates are only significant for the sixth and ninth deciles. Only the sixth and tenth deciles are positive and significant at levels higher than log(11). For the most part, the CDF differences in the figure and table 3 are ordered by an increasing share of eligible. This pattern is especially evident in the log(9) specification. This is comforting because it implies that the differences reflect the effects of the dissemination scheme as would be expected. In addition, the figure is another check of the monotonicity assumption. Since none of the CDF differences are negative, they lie below the first decile CDF, which we assumed in the previous section.

Figure 6. *Differences in log total visit CDFs by share of discount-eligible in deciles*



Notes: The figure shows the weighting scheme in the IV estimator. The weights are calculated as the (1-CDF) differences between municipalities in the second to tenth decile and the reference group equal to municipalities in the first decile.

Table 3. *The instrument induced effects on discrete levels of total visits*

	Total visits greater than or equal to				
	$log(7)$	$log(8)$	$log(9)$	$log(10)$	$log(11)$
Dependent variable mean	0.997	0.976	0.702	0.258	0.165
Decile					
2nd	0.030	0.105	0.230	-0.000	-0.000*
	(0.030)	(0.077)	(0.197)	(.)	(0.000)
3rd	0.030	0.133*	0.422**	-0.000	-0.000**
	(0.030)	(0.072)	(0.197)	(.)	(0.000)
4th	0.030	0.095	0.537***	0.194	-0.000
	(0.030)	(0.082)	(0.172)	(0.167)	(0.000)
5th	0.030	0.133*	0.434**	-0.000	-0.000***
	(0.030)	(0.072)	(0.198)	(.)	(0.000)
6th	0.030	0.133*	0.756***	0.721***	0.721***
	(0.030)	(0.072)	(0.134)	(0.229)	(0.229)
7th	0.030	0.133*	0.564***	-0.000	-0.000
	(0.030)	(0.072)	(0.210)	(.)	(0.000)
8th	0.030	0.133*	0.627***	-0.000	-0.000***
	(0.030)	(0.072)	(0.170)	(.)	(0.000)
9th	0.030	0.107	0.601***	0.551***	-0.000
	(0.030)	(0.077)	(0.181)	(0.207)	(0.000)
10th	0.030	0.133*	0.793***	1.000	1.000***
	(0.030)	(0.072)	(0.126)	(.)	(0.000)

Notes: The table shows the effects of the nine instruments on discrete levels of log total visits. The estimates are obtained from a regression of a dummy for the total number of visits being greater than or equal to the specified threshold on all nine decile dummies. The valid sample has been used. Standard errors are corrected for municipality clustering and reported in parentheses. *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6 External returns to theater consumption

This section presents the results of the external returns to theaters. We present results for the valid sample and two separate sub-samples. One only includes theatergoers and one without these individuals. Furthermore, we test the robustness of our results using additional regional variation.

6.1 Results for the valid sample

If the assumption regarding external benefits is valid, we should expect to find positive and significant estimates. In table 4 we report estimates for the external returns of theaters with various specifications for the valid sample. In column (1), we do not include any covariates in the regression. Column (2) includes a set of *structural* controls equivalent to those implied by the theoretical model. These include the log of individuals' yearly income excluding wealth, the number of visits to a theater within the last 12 months, and how much they have spent on these theater tickets. Column (3) of the table controls for individuals' years of education, age, gender, number of children living at home, their marital status, and whether or not they are immigrants. Column (4) includes controls for the municipalities. These controls include the size of the population, a dummy equal to one if it has a higher educational institution, a dummy for the number of theaters, and regional dummies[15]. Lastly, column (5) is a robustness check of the fully-specified overidentified 2SLS estimates in (4) using *Limited Information Maximum Likelihood* estimation (LIML). With more than one instrument, LIML tends to be less biased than 2SLS (Angrist and Pischke, 2009). Note that the estimates found in columns (4) and (5) are our main specifications because they satisfy our assumptions outlined in section 5.

Section (a) of the table shows the reduced form relationship between individuals' valuations and aggregate demand. The middle section, (b), shows the first-stage relationship between decile dummies and the log of total visits.

The first-stage results all have the expected signs and magnitudes in the first three specifications. All but the second decile are also significant. This is comparable to what we found in table 3 where the second decile was not significantly different from zero either. However, adding municipality-specific covariates substantially affects the first-stage results. All of the coefficients are remarkably reduced and imprecisely estimated. Only the eighth and tenth decile dummies are significantly different from zero. The F-statistics in the fully specified model is close to 6 compared with 139.7 and 191.9 in the preceding specifications. Because the F-statistic in the fully specified model is below 10, it may indicate a weak first stage (Stock et al., 2002).

The IV estimate of the external return to theaters without covariates is 0.485, which is 20 percent higher than the corresponding OLS estimate of 0.389 reported in table 2. The IV estimate should be interpreted as the average effect of a one percent increase in aggregate demand on the valuation of theaters for individuals living in municipalities whose total number of visits is influenced by the ticket purchasing scheme. The 95 percent confidence interval for the IV estimate is [0.304, 0.666], which includes the OLS estimate. Adding structural and individual-specific covariates lowers the estimates but also increases precision slightly. Again, neither specifications are significantly different from the OLS estimates. The IV estimate is 0.637, but insignificant in our main model. This result suggests that, on average, community consumption is not a cause for individuals' welfare. In turn, this implies

[15] Definitions for the controls can be found in table 1.

that there are no external returns to theaters. However, if the first-stage is, in fact, weak, the 2SLS estimator will be biased towards OLS and, as such, the conclusion that there are no external returns to theaters may not be legitimate. Nonetheless, using the LIML estimator, which is less biased, produces a very similar estimate of 0.652, but not as precise. We return to the issue related to the potential weak first-stage in section 6.4.

Overall, table 4 suggests that there are external returns to theaters on average if we do not control for municipality-specific controls. However, these estimates are not identified, and there is no external return to theaters on average in our fully-specified models. Furthermore, the IV estimates are mostly a bit larger than the corresponding OLS estimates but not significantly different. Surprisingly, the results suggest that the observed association between valuation and the total number of visits is not driven by omitted variables such as quality and preferences.

Table 4. *Estimates of the external returns to theaters*

	2SLS				LIML
Valid sample	(1)	(2)	(3)	(4)	(5)
(a) Results using deciles as instruments					
External returns of theaters	0.485***	0.367***	0.333***	0.637	0.652
	(0.0926)	(0.0883)	(0.0894)	(0.686)	(0.722)
(b) First stage for log of total visits					
Dummy for decile = 2	0.263	0.272	0.276	0.111	0.111
	(0.178)	(0.175)	(0.174)	(0.0990)	(0.0990)
Dummy for decile = 3	0.598***	0.604***	0.593***	0.104	0.104
	(0.173)	(0.173)	(0.166)	(0.0875)	(0.0875)
Dummy for decile = 4	0.718***	0.703***	0.688***	0.154	0.154
	(0.268)	(0.255)	(0.242)	(0.103)	(0.103)
Dummy for decile = 5	0.596***	0.595***	0.611***	-0.0291	-0.0291
	(0.198)	(0.196)	(0.189)	(0.120)	(0.120)
Dummy for decile = 6	2.672***	2.633***	2.555***	0.0658	0.0658
	(0.567)	(0.562)	(0.547)	(0.127)	(0.127)
Dummy for decile = 7	0.890***	0.883***	0.857***	-0.0537	-0.0537
	(0.234)	(0.228)	(0.227)	(0.101)	(0.101)
Dummy for decile = 8	0.670***	0.655***	0.649***	0.181**	0.181**
	(0.188)	(0.188)	(0.183)	(0.0907)	(0.0907)
Dummy for decile = 9	1.301***	1.269***	1.236***	0.122	0.122
	(0.345)	(0.347)	(0.346)	(0.105)	(0.105)
Dummy for decile = 10	2.680***	2.651***	2.573***	0.423***	0.423***
	(0.135)	(0.135)	(0.133)	(0.125)	(0.125)
Structural covariates		✓	✓	✓	✓
Individual covariates			✓	✓	✓
Municipality covariates				✓	✓
No. of obs.	1,231	1,231	1,231	1,222	1,222
F-statistics (excluded instruments)	201.5	191.9	139.7	6.326	6.326

Standard errors corrected for municipality clustering are reported in parentheses.
$^{*}p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

6.2 Theatergoers external benefits

The result presented for the valid sample suggested that, on average, there may be no external returns to theaters. Nevertheless, this may be driven by differences between those that use the theaters regularly and those who do not. The theoretical model outlined in section 2.2 and 2.3 may explain this hypothesized difference. Recall that for the external return to be positive, it must be the case that other individuals' consumption, the generator of public characteristics in the model, is complementary to individual consumption. When the total number of theatergoers increases, so does individual consumption. For example, because an individual takes greater pride in the theater as more in its community use it. So, according to the theoretical model, we should not expect those who do not use theaters to view them as complements. It should influence their choice of participation and, therefore, their valuation if they did. In sum, the average effect may be driven by two types of individuals, the users, and non-users, whose external returns pull in opposite directions. In this section, we present results for the sample of theatergoers. We return to non-users external returns in section 6.3.

Table 5 presents estimates for the sub-sample of those that have attended a theater within the last twelve months. The table is similar to the one reported for the valid sample and contains the same model specifications. The first-stage in this sub-sample is comparable to the valid sample with two noticeable differences. The second decile is now significant in two specifications, and the fourth decile is significant across all specifications. The fourth decile significance contributes to a marginally higher F-statistics of 7.5 in the fully specified model. Users' external returns to theaters are remarkably higher than the average effect in the fully specified model. The IV estimate is 2.411 and highly significant with 2SLS and a bit larger but less precise with LIML. As before, the IV estimates are not significantly different from any of the corresponding OLS estimates. However, the OLS estimate is significant at a 5 percent level in the last specification, whereas the 2SLS estimate is significant at a 1 percent level. Hence, these results suggest that there are cultural-capital externalities to theaters for those who use them. Intuitively, these results seem reasonable. The users are more familiar with the theatre good and therefore, they may be better equipped to valuating the benefits. Another reason can be, is what we find is simply network effects. The users benefit from having many other users in their community, as they will have more people to talk to about their theatre experience (one possible benefit from the higher cultural capital in the society).

6.3 Non-users external returns to theaters

Table 6 reports estimates for the sub-sample of non-users. The interpretation of the table is similar to before, but the estimated model is slightly different from the previous specifications. Specifically, we assume that non-users have no taste for the private characteristics of theaters. This is equivalent to setting β equal to zero in the theoretical model. Consequently, non-users inverse demand functions are not a function of this parameter, and neither is the structural model. Furthermore, by not having bought any theater tickets within the last twelve months, they have not spent any income on these.

The first-stage results are significant for all but the second decile in the first three specifications, and only the tenth decile is significant in the last. This is similar to the results reported in table 4 for the entire valid sample. Interestingly, the external returns are all positive but lower than in the valid sample and for users in the first three specifications. In the main model, the estimate is -1.191, which is markedly different from what was found in the two other samples. On the other hand, the LIML

Table 5. *Estimates for users external returns to theaters*

	2SLS				LIML
Subsample for theatergoers	(1)	(2)	(3)	(4)	(5)
(a) Results using deciles as instruments					
External returns of theaters	0.456***	0.436***	0.483***	2.411***	2.759***
	(0.100)	(0.115)	(0.128)	(0.880)	(1.058)
(b) First stage for log of total visits					
Dummy for decile = 2	0.275	0.277*	0.276*	0.127	0.127
	(0.173)	(0.168)	(0.161)	(0.114)	(0.114)
Dummy for decile = 3	0.553***	0.563***	0.577***	0.0985	0.0985
	(0.167)	(0.170)	(0.159)	(0.107)	(0.107)
Dummy for decile = 4	0.864***	0.837***	0.803***	0.241**	0.241**
	(0.326)	(0.310)	(0.293)	(0.118)	(0.118)
Dummy for decile = 5	0.545***	0.540***	0.587***	-0.00909	-0.00909
	(0.175)	(0.173)	(0.164)	(0.138)	(0.138)
Dummy for decile = 6	2.739***	2.704***	2.617***	0.127	0.127
	(0.479)	(0.480)	(0.477)	(0.126)	(0.126)
Dummy for decile = 7	0.909***	0.893***	0.879***	-0.0531	-0.0531
	(0.216)	(0.213)	(0.234)	(0.103)	(0.103)
Dummy for decile = 8	0.565***	0.560***	0.564***	0.199**	0.199**
	(0.172)	(0.169)	(0.158)	(0.0856)	(0.0856)
Dummy for decile = 9	1.227***	1.197***	1.173***	0.162	0.162
	(0.334)	(0.335)	(0.332)	(0.116)	(0.116)
Dummy for decile = 10	2.597***	2.564***	2.480***	0.499***	0.499***
	(0.106)	(0.108)	(0.111)	(0.131)	(0.131)
Structural covariates		✓	✓	✓	✓
Individual covariates			✓	✓	✓
Municipality covariates				✓	✓
No. of obs.	556	556	556	554	554
F-statistics (excluded instruments)	190.1	168.6	117.5	7.292	7.292

Standard errors corrected for municipality clustering are reported in parentheses.
$^*p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

estimate is -1.224, which is similar. Nonetheless, all estimates are insignificant and not different from the OLS estimates. Thus, the estimates suggest that arts consumption by others within a community do not influence the welfare for those who never or seldom go to the theater.

Table 6. *Estimates for non-users external returns to theaters*

	2SLS				LIML
Subsample for non-users	(1)	(2)	(3)	(4)	(5)
(a) Results using deciles as instruments					
External returns of theaters	0.258*	0.258*	0.170	-1.191	-1.224
	(0.132)	(0.133)	(0.154)	(0.902)	(0.929)
(b) First stage for log of total visits					
Dummy for decile = 2	0.274	0.275	0.278	0.0973	0.0973
	(0.206)	(0.206)	(0.204)	(0.101)	(0.101)
Dummy for decile = 3	0.629***	0.630***	0.611***	0.110	0.110
	(0.204)	(0.204)	(0.198)	(0.0849)	(0.0849)
Dummy for decile = 4	0.624**	0.624**	0.608**	0.104	0.104
	(0.246)	(0.245)	(0.239)	(0.0991)	(0.0991)
Dummy for decile = 5	0.632***	0.632***	0.631***	-0.0497	-0.0497
	(0.237)	(0.238)	(0.230)	(0.114)	(0.114)
Dummy for decile = 6	2.537***	2.538***	2.466***	0.0341	0.0341
	(0.659)	(0.660)	(0.639)	(0.131)	(0.131)
Dummy for decile = 7	0.872***	0.875***	0.852***	-0.0522	-0.0522
	(0.258)	(0.259)	(0.252)	(0.114)	(0.114)
Dummy for decile = 8	0.750***	0.749***	0.732***	0.168	0.168
	(0.218)	(0.218)	(0.216)	(0.103)	(0.103)
Dummy for decile = 9	1.347***	1.347***	1.314***	0.0923	0.0923
	(0.374)	(0.374)	(0.375)	(0.100)	(0.100)
Dummy for decile = 10	2.736***	2.735***	2.667***	0.369***	0.369***
	(0.177)	(0.177)	(0.176)	(0.128)	(0.128)
Structural covariates		✓	✓	✓	✓
Individual covariates			✓	✓	✓
Municipality covariates				✓	✓
No. of obs.	675	675	675	668	668
F-statistics (excluded instruments)	210.7	209.8	154.9	4.650	4.650

Standard errors corrected for municipality clustering are reported in parentheses.
$*p < 0.10$, $**\ p < 0.05$, $***\ p < 0.01$.

6.4 Allowing for variation across regions

Although the ticket purchasing scheme applies to all theaters that receive public funding, irrespective of their geographical location, the number of publicly funded theaters varies between municipalities and consequentially across regions. For example, above 50 percent of the theaters are located in the Capital Region of Denmark, and roughly 12 percent are located in the Southern Denmark Region. Therefore, the relationship between aggregate demand and the share of discount-eligible individuals is expected to vary among regions that have a different amount of publicly funded theaters. This additional variability can be used to improve the precision of the IV estimates presented above. We incorporate the regional variation by including a set of nine decile dummies interacted with four regional dummies. In total, we now have 36 instruments. The estimates also include the four regional dummies in the reduced form. Therefore, as before, the variability in aggregate demand is solely due to differences in the share of discount-eligible. However, unlike before, the share of discount-eligible is now allowed to vary by region.

Table 7 presents the IV estimate for the new specification. For the sake of comparison, we have also included the OLS estimates in column (1) and *baseline* IV specification in column (2). We also include estimates for the valid sample as in table 4 and the two sub-samples. Allowing for regional variation results in approximately a 55 percent reduction in the standard errors of the IV estimate in the valid sample. Furthermore, the first-stage F-statistic of the excluded instrument is 840.3 compared to 6.326 in the baseline specification. Hence, we no longer suspect a weak first-stage. In the new specification, the IV estimate is 0.374, which is lower than the previous IV estimate but also slightly lower than the corresponding OLS estimate. However, they are still not significantly different.

In the two sub-samples, the estimates are also more precise than before. For users, the reduction in the standard errors is 43 percent, and for non-users, 70 percent. As in the valid sample, the F-statistic is markedly improved and shows no signs of being weak. The magnitude of both estimates is smaller than the baseline and closer to the OLS estimates. For the sub-sample of users, the estimate is 1.388 significant on a five percent level, and for non-users, the estimate is -0.725 and insignificant.

On balance, allowing for regional variation increases precision due to a stronger first-stage but does not change the overall conclusion.

Table 7. *Estimates for the external return to theaters allowing for variation across regions*

	OLS	2SLS	
	(1)	(2)	(3)
(a) Full sample			
External return	0.418	0.637	0.374
	(0.312)	(0.686)	(0.441)
F-statistics		6.326	840.3
Excluded-instruments		9	36
(b) Users			
External return	0.992**	2.411***	1.388**
	(0.428)	(0.880)	(0.617)
F-statistics		7.292	293.1
Excluded-instruments		9	36
(c) Non-users			
External return	-0.065	-1.191	-0.725
	(0.386)	(0.902)	(0.532)
F-statistics		4.650	184.3
Excluded-instruments		9	36
Structural covariates	✓	✓	✓
Individual covariates	✓	✓	✓
Municipality covariates	✓	✓	✓

Standard errors corrected for clustering in parentheses.
*$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

7 Concluding remarks

Public spending on theaters rests on the assumption that they yield positive external benefits. Several studies have previously investigated the external and public good benefits of cultural goods and theaters. A common finding across studies is that individuals who do not use the good in question typically tend to value them, though to a much lesser extent than the users.

While most externalities and public good characteristics like prestige value, bequest value and option value are related to the supply of a cultural good, the are some externalities which are thought to be related to consumption. We refer to these as cultural-capital externalities, as they will increase with the quantity of consumption of a cultural good. In this paper we are testing the existence of these cultural-capital externalities. We are doing it based on a model inspired by Cornes and Sandler, 1984, 1994, 1996 where a private consumption jointly produces a private and a public good. These cultural-capital externalities are expected to be related to individuals being enlightened and empowered, such as: better understanding of one-self and other people, changed perceptions, increased creativity, aesthetic understanding, social critique. The expectation is that there are furthermore external returns to the society in the form of e.g. increased awareness, democracy, diversity, innovation and so on. The important point is that these consumer externalities are transmitted through the individuals (users) consumption by means of social activities and interactions among human beings. Without the consumption by the users, no public good benefit or externalities are produced. The existence of these cultural-capital externalities is inherently a causal question and has not previously been treated as such.

This paper outlines an augmented quasi-public good model for theater consumption. It describes both the private benefits theatergoers receive and the perceived external benefits they are thought to generate within a community. We show that the sign of the putative externalities is not given *a priori*. Although we use the model to analyze the characteristics of theater consumption, it is quite general, and can be extended to other cultural goods where cultural-capital externalities are expected to exist.

We derive an empirical model from the theoretical model of the relationship between individuals' valuation, of theaters and aggregate demand within a municipality. The source of identification is variation in aggregate demand that results solely from differences in the share of individuals below 25 years of age in a municipality, which in turn results from the effect of a national ticket purchasing scheme.

Data on individuals' valuation are taken from a Contingent Valuation study carried out on the Danish population in the first half of 2020. In our main specification, the IV estimate of the external return is 0.637 on average and insignificant. However, using only the sample of theater attenders, we find a large and significant external return of 2.411 percent, whereas it is -1.191 and insignificant for the sub-sample of non-users. Allowing for variation across regions increases the precision but lowers the magnitude of the estimates. Nevertheless, the overall pattern is the same.

In sum, our results points to the existence of cultural-capital externalities for user, but not for non-user. Intuitively, these results seem reasonable. The users are more familiar with the theatre good and therefore, they may be better equipped to valuating the benefits. Another reason can be, is what we find is simply network effects. The users benefit from having many other users in their community, as they will have more people to talk to about their theatre experience (one possible benefit from the higher cultural capital in the society).

However, there are several limitations of our study to be aware of. First, our approach only captures local externalities generated within a municipality. They do not reflect any national externalities that may exist. Moreover, the IV estimates do not apply to all municipalities in Denmark. They apply to 65 out of 80, not including our reference group.

A more serious limitation is that we use WTP from a contingent valuation study as the outcome measure. It is an important prerequisite of stated preference studies that the benefits are explained to the respondents in a scenario. However, the cultural-capital externalities are impossible to explain to the respondents in scenario, which seriously may harm the WTP measure as an indicator for cultural-capital externalities, especially for the non-users.

However, our study has shown that it is possible to test the existence of externalities of cultural consumption in an empirically convincing causal set-up. To the best of our knowledge, out study is the first study trying this approach.

We recommend that much more research is needed to get a better understanding of the externalities in the arts and culture. Especially, there is a need for finding better outcome measures than WTP. The existence of these externalities are truly important for our understanding of the values of arts and culture and in terms of providing guidance for cultural policy decisions.

Appendices

A1 Relation between the expenditure- and distance function

To see the relation between the expenditure- and distance function suppose that for arbitrary c, x, Z and p that $E(\cdot) = 1$. Furthermore, suppose that δ is chosen such that $\frac{c_{im}, x_{im}, Z_m}{\delta} = \bar{u}$. Then it must hold that $E(\cdot) = \frac{1}{\delta}\left(c + \frac{px}{\beta}\right)$ so $D(\cdot)E(\cdot) = c + \frac{px}{\beta}$ because $D(\cdot) = \delta$ from the definition in (11). Therefore, $D(\cdot) = \frac{1}{E(\cdot)}\left(c + \frac{px}{\beta}\right) = c + \frac{px}{\beta}$ if and only if $E(\cdot) = 1$. It then follows that we can express the distance function as:

$$D(p, \widetilde{Z}_m, \beta, \gamma, u_{im}) = \min_{p} \left\{ c_{im} + x_{im}\frac{p}{\beta} \mid E(\cdot) = 1,\ \beta\widetilde{Z}_m = \beta Z_m - \gamma x_{im} \right\}$$

A2 The Questionnaire

The valuation responses we use in this paper are taken from the following questions. The survey included many other questions and scenarios, but we only outline those used. The questionnaire was presented in Danish but has been translated to English below.

1. All taxable Danes pay to the publicly supported theaters through their taxes. Do you generally think it is okay to pay for the theaters via your tax payments to the state and the municipality?

2. Think for a moment about what the total number of theaters in Denmark is worth for you, even if you may not use the theaters that much yourself.

3. Under normal conditions without the current Corona crisis: How much are you willing to pay *a year* to the theaters in Denmark through your tax payments? Remember to consider your income situation when answering and that you actually both want and can pay the amount you specify when it comes down to it. Remember that the money you pay for the theaters could alternatively have been used for other public purposes or could have been included in your private consumption and been used for food, clothes, a trip to the cinema, or completely different things.

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