

## On the optimal level of theatre subsidies

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The aim of this paper to justify the high share of public subsidies to theatre sector and to show that ticket pricing should be in the inelastic segment on the demand schedule. The theoretical model is tested with Finnish data. The model follows the ideas presented by Prieto-Rodríguez and Fernández-Blanco (2006), however, here they were using a more general functional form while here a more detailed functions are used and therefore the results are more limited and cannot be generalised.

The principal-agent model in which the principal, i.e. the arts ministry commands the agent, i.e. the theatre manager to take actions on the principal's behalf motivated by a monetary reward. The optimal subsidy is positive more probably if the price elasticity of theatre performances is inelastic.

Using a Finnish data covering 58 theatres (subsidised by law) during a five year period from 2007 to 2011 reveals that the price elasticity of theatre performances is inelastic. If the subsidy is positive, an increase in the number of visitors increases also optimal subsidies but less than proportionally indicating that the share of public subsidies should be lower in larger towns where the potential for theatre visits is higher due to a larger population

## On the optimal level of theatre subsidies

### Introduction and motivation

The theatre and orchestra law (705/92) that has come into force in 1993 brought considerable changes to theatre financing in Finland. All together the state subsidies (“funding bill”) to the theatres and orchestras in 2007 were about 47M€ and to the National Opera about 31M€. In addition to some minor theatre groups received discretionary about 1,5M€ state subsidies. In addition, the municipalities support the above-mentioned institutions and groups with about 63M€. In practice, this means that the income share of state and municipal subsidies was 25 % and 43 % for theatres excluding the National Theatre and the National Opera. The share of other incomes (sales of the programme, interest revenue) was about 5% and the rest, i.e. 28% comes from ticket revenues. The full time equivalent (FTE) person years is used as criteria for public subsidies.

The FTE person years as criteria and the true (verified) person years have not been equivalent over the years since 1993. The true change is higher than the criteria. Also the change in the unit cost as criteria for state and the verified unit cost has been lower<sup>1</sup>, however, during two decades from 1993 the change (growth) in state subsidies and ticket revenues has been substantially higher than the change in municipal subsidies (( Kangas & Kivistö 2011,17)). The state support is directed to the administrator of the culture institution, municipality or federation of municipalities, to a private community or foundation. As a rule, the state subsidy is 37 per cent of the price of the person year with certain exceptions<sup>2</sup>. Since the share of public subsidies is so big, it is important that these cultural institutions

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<sup>1</sup> Report of a committee on the system of statutory state aid granted to theatres, 2003, 23, 26

<sup>2</sup> During the years, 1993 and 1995 the state aid was determined by the financial classification of the location municipality of the theatre and it varied between 25 – 40 per cent. The state aid to Tampereen työväen teatteri (the only professional

and groups should pursue efficiency and respect high quality and cultural diversity. Most of plays in theatres are drama plays but from the point of view of incomes the musical plays are essential since they appeal to the public.<sup>3</sup> On the other hand, musical plays might be more expensive since the artistic staffs consist of not only actors but also musicians.

According to the ownership, the theatres can be classified into full municipal theatres and private theatres. Some of the private theatres serve as a part of the municipality conglomerate in which case the privacy brings about some financial independence in comparison with other municipal bodies like primary school or local health care centre. The administrative models of theatres are mostly an association, a foundation or a limited company. The National theatre which is mainly financed by the state is a limited company with a foundation as formal owner. The Finnish National Opera is governed by the Foundation of the Finnish National Opera and 70 per cent of the funding comes from the state. The theatre management see the advantage of the privacy as less bureaucracy and increase in the freedom of theatres (( Kanerva & Ruusuvirta 2006,11)).

The aim of this paper to justify the high share of public subsidies to theatre sector and to show that ticket pricing should be in the inelastic segment on the demand schedule. The theoretical model is tested with Finnish data. The model follows the ideas presented by ( Prieto-Rodríguez & Fernández-Blanco 2006)however, here they were using a more general functional form while here a more detailed functions are used and therefore the results are more limited and cannot be generalised.

## Related literature

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workers theatre in Finland) and to Svenska Teatern i Helsingfors (the biggest Swedish speaking theatre) is 60 per cent (Report of a committee on the system of statutory state aid granted to theatres, 2003, 18).

<sup>3</sup> During the theatrical seasons 2007/2008 – 2009/2010 the musical plays' share of performances was on average 14-15 % while the share of sold tickets was 25-29 %. Plays for children and youth and puppet plays had a lower sold ticket share than their share of performances.

The measurement of the achievement of the cultural institutions is complicated by the presence of goals of different nature. The main objectives and obligations set to the theatres subsidised by law (VOS-theatres) are related to regular presentation activity, to spectator number and to the number of premieres or performances ( Kanerva & Ruusuvirta 2006, 88) . It is troubled to measure the achievement of the theatre due to the multiple goals. On one hand, it is important that there are many visitors, since it has been shown that scale economies exist (Taalas 1997) and average costs decline, however, on the other hand, it is also important that there are many performances and many different plays since the cultural diversity increases. This in turn can lead to allocative inefficiency. Taalas (1997) proposes that on average in Finland the actual total costs exceeded the minimum cost by some 5 per cent in the 1980's and 1990's. The non-optimal usage of inputs may originate from the managers' desire for big audiences, big budgets and high quality of production. Performances offer viewers cultural experience but also entertainment. The theatregoers prefer large productions in terms of cast size ( Werck & Heyndels 2007) and less esoteric performances ( Jenkins & Austen-Smith 1987). The reputation of the author, producer and cast has a positive impact on the spectator number (Abbé-Decarroux 1994). Cultural diversity in terms of the number of productions in a theatre is associated with public subsidies. Higher public funding is positively related to the number of productions a theatre mounts and negatively related to the conventionality of theatre programs (Austen-Smith 1980, DiMaggio & Stenberg 1985, O'Hagan & Neligan 2005, Werck, Stultjes & Heyndels 2008). On the other hand, a bigger budget which is partially financed by public subsidies leads to higher cast and therefore to bigger audience (Werck et al. 2008). Other indicators set to the VOS-theatres are a euro-denominated sales objective and a versatile, interesting and high-quality programme as such ( Kanerva & Ruusuvirta 2006,89). In the biggest towns the theatres have segmented according to objectives and for example there is own programme for children, for example puppet theatre. In bilingual municipalities (Finnish and Swedish) the presentations are expected on both domestic languages. For private theatres the objectives are specified usually between the municipality and the theatre every year

in connection with acceptance of the municipal budget. The objectives can be based and they can be included to the service agreement in which the common goals are set. The subscriber-producer (public-private partnership) or the service agreement defines carefully the charges and indicators. The representatives named by the municipality can be members in the board of the private theatres (Kanerva & Ruusuvirta 2006).

We can classify theatres according to their organisational models as follows: a theatre factory produces standard quality and quantity as much as possible, director's theatre in which the director is the creative motor of the process and a group theatre which is a collective unit. In theatre factory there is clear distinction between artistic and non-artistic staff and they have their own management process and directors. Specialisation between different professionals in a director's theatre is not exact. The director is the managing director and the administrative director. A group theatre does not have any administrative director and the organisation is lean so that separation between artistic and non-artistic staff is low.

The arts and culture policy where we have different transactions between the arts ministry and private theatres are included has recently focused on using a bargaining theory. The principal has a different target, like maximising the number of theatre attendance in relation to subsidises than an individual theatre manager who wants to maximise profit given the subsidies from the ministry. The choice is delegated: one theatre has the responsibility for taking decisions supposedly in the interest of the ministry (the whole society) in return for some kind of payment. The theory of principal and agent is designed to apply a situation where one individual, called the agent must choose some action  $a$  from a given set of actions  $\{a\}$ . The outcome  $x$  which results from this choice depends also on from a given set of states of the world  $\{\theta\}$  which is not known in advance. The outcome  $x$  generates utility to the second (the ministry), the principal  $P$ . A contract must be defined under which  $P$  makes a payment  $s$  to the agent.

The principal-agent model in which the principal, i.e. the arts ministry commands the agent, i.e. the theatre manager to take actions on the principal's behalf motivated by a monetary reward. The environment is uncertain and the principal and agent have differing information on the aspects of this uncertainty. The uncertainty in the culture sector refers to a situation in which the outcomes are not directly linked to inputs or effort. When the outcome is revealed that does not unambiguously imply anything about effort or skill. If the manager reports large increases in the number of theatre visitors that does not necessarily mean that the repertoire has been excellent. It is also possible that in the relevant area, the theatre is a monopoly and there has been a substantial increase in the population. The principal-agent problem characterises a situation where self-interested managers enter into an implicit or explicit contract with the ministry.

Market failure since the transmission of music through radio broadcasts allows music listeners to record the music free of charge and the songwriter and performers receive no reward (Thorsby 2010,36). Government subsidy could be seen as a response to market failure. Due to equal treatment if philharmonic orchestras are subsidised then the substitutes for orchestra performances, like theatre performances must be subsidised also. On the other hand, arts institutions often operate as monopolists in their local market. Infrequently there is more than one art museum, professional philharmonic orchestra or opera in a town. Although these institutions are often organised on a non-profit basis, they often charge prices above marginal cost, not because they are maximising profits but because they operate under conditions of decreasing average costs. Such an outcome is economically inefficient and output is less than the socially optimal output. If an arts institution is a local monopoly, the equilibrium price level of the monopoly is too high from the viewpoint of social benefit. Therefore, it is reasonable that the ministry is subsidising arts institutions. Moreover, preserving and creating art and culture as a legacy to future generations justifies subsidies. It forms a collective benefit (Peacock 2006). In addition the state subsidy system can be justified by the Baumol's cost disease ( Baumol &

Bowen 1966). Labour productivity progress in cultural sectors, especially in the theatre is low since live performing arts are labour intensive. While labour costs of producing a performance increase over time in line with the other sector of the economy, labour productivity will remain unchanged. The theatre is inclined to profitability problems.

### A model for optimal subsidy scheme

Principal (ministry) and agent (theatre manager) are maximising expected utility,  $u$  and  $v$ . If the ministry is risk-neutral and the theatre manager is risk averse, a typical principal-agent model results in the agent receiving a fixed fee leaving all of the risk of a variable cash flow with the principal (Strong & Waterson 1990). This is the classic moral hazard case where the theatre manager's incentive is to act at a lower level since the ministry can only observe an imperfect measure of the manager's action. The standard principal-agent model (Rees 1987) shows how an optimal subsidy (fee) schedule is related to risk aversion of the ministry and theatre manager. The optimal subsidy schedule exchanges the benefits of risk sharing with the costs of providing an incentive to the theatre manager. The optimal schedule defines a risk-sharing fee  $s^*(\theta)$  from the ministry to the theatre. It maximises ministry's expected utility  $u$  for some given level of theatre manager's utility  $\bar{v}^0$ .

$$(1) \max_{s(\theta)} \int_0^1 u(n(e^0, \theta) - s(\theta))f(\theta)d\theta \text{ s. t. } \int_0^1 v(e^0, s(\theta))f(\theta)d\theta \geq \bar{v}^0$$

The solution  $s^*(\theta)$ , which specifies the subsidy from the ministry to agent at each,  $\theta$  is the following

$$(2) -u'(n - s^*) + \lambda v_s = 0$$

where  $\lambda$  is the conventional Lagrange multiplier and not a function of  $\theta$ . If two different states of the world ( $\theta_1 \neq \theta_2$ ) then the first order conditions imply

$$(3) \frac{u'(\theta_1)}{v_s(\theta_1)} = \frac{u'(\theta_2)}{v_s(\theta_2)} \Rightarrow \frac{u'(\theta_1)}{u'(\theta_2)} = \frac{v_s(\theta_1)}{v_s(\theta_2)}$$

meaning that the optimal risk sharing is when the ministry's and theatre manager's marginal rate of substitution of income between any two states of the world ( $\theta$ ) are equal. Differentiating the first order condition (2) with respect to  $\theta$  results in

$$(4) -u'' \left( \frac{\partial n}{\partial \theta} - \frac{\partial s^*}{\partial \theta} \right) + \lambda v_{ss} \frac{\partial s^*}{\partial \theta} = 0$$

Using the Arrow-Pratt indices of risk aversion  $r_P = -\frac{u''}{u'}$  and  $r_A = -\frac{v_{ss}}{v_s}$  and recalling that  $\lambda = \frac{u'}{v_s}$

the above yields

$$(5) \frac{\partial s^*}{\partial \theta} = \frac{r_P}{r_P + r_A} \frac{\partial n}{\partial \theta}$$

Given risk aversion if  $\theta$  increases, subsidy ( $s$ ) increases but with a slower rate. This result proposes using a linear subsidy schedule  $s^*(\theta) = \frac{r_P}{r_P + r_A} n + \bar{S}$  in which  $\bar{S}$  is a constant. However, if the ministry is risk neutral,  $r_P = 0$  then  $s^*(\theta) = \bar{S}$  and if the theatre manager is risk neutral,  $r_A = 0$  then  $s^*(\theta) = n - \gamma$  implying that the theatre manager pays a fixed payment  $\gamma$  to the ministry and takes the residual income.

However, in the case of optimal subsidy it is not enough to relate that only to managers' and ministry's risk aversion. We should study how an optimal subsidy is related to demand conditions. Following the ideas of Peacock (2006) and Thorsby (2010) both the state and local municipalities are subsidising local private theatres in order to increase the number of theatre visits. Therefore, the public subsidy should depend on the number of theatre visitors and following the standard principal-agent model (Rees 1987) the schedule is linear. The model below follows the ideas presented by Prieto-Rodríguez and Fernández-Blanco (2006). They are using a more general function while the model below uses a more detailed function form.



The arts ministry wants to maximise the common objective function  $U_A$  that includes the number of visitors,  $n_i$  but the marginal rate is utility is diminishing, and the public subsidy,  $s_i(n_i) = s_i n_i$  that depends on the number of visitors. As the number of visitors increases, so does the subsidy. The objective function

$$(6) U_M = (n_i^{1/2} - s_i n_i)$$

The utility function of the theatre is additively separable with two parts: incomes from ticket sales,  $n_i \cdot p_i = \alpha p_i^{-\beta+1}$  and public subsidy,  $s_i n_i$  and costs due to using actors and other staff,  $v_i(e) = v_i e^2$ . The ticket revenues,  $n_i \cdot p_i$  where  $n_i$  is related to price,  $p_i$  and other relevant attributes ( $\alpha$ ):  $n_i = \alpha p_i^{-\beta}$ . The price elasticity is  $-\beta < 0$ . The other relevant attributes include incomes of the consumers and other leisure activities (substitutes, like cinema or sport events).

$$(7) U_T = n_i \cdot p_i + s_i n_i - v_i e_i^2 = \alpha p_i^{-\beta+1} + s_i \alpha p_i^{-\beta} - v_i e_i^2$$

A larger level of using actors and staff or simply effort,  $e$  will reduce the overall utility of the theatre manager but it will increase the number of visitors.

The ministry's problem is to

$$(8) \text{MAX}_{e, s_i, p} \sum_{i=1}^N \pi_i(e) (\alpha^{1/2} p_i^{-1/2\beta} - s_i \alpha p_i^{-\beta})$$

subject to

$$(9) \sum_{i=1}^N \pi_i(e) [\alpha p_i^{-\beta+1} + s_i \alpha p_i^{-\beta} - v_i e_i^2] \geq \underline{U}$$

where  $\pi_i$  is the probability of getting a certain number of visitors,  $n_i$  given the effort,  $e$ , of the theatre manager. The Lagrange function connected with this set of problems is

$$\begin{aligned}
(10) \quad \mathcal{L}(e, s_i, p) &= \sum_{i=1}^N \pi_i(e) (\alpha^{1/2} p_i^{-1/2\beta} - s_i \alpha p_i^{-\beta}) \\
&+ \lambda \left\{ \sum_{i=1}^N \pi_i(e) [\alpha p_i^{-\beta+1} + s_i \alpha p_i^{-\beta} - v_i e_i^2] - \underline{U} \right\}
\end{aligned}$$

The first order conditions of this programme are:

$$\begin{aligned}
(11) \quad \frac{\partial \mathcal{L}}{\partial e} &= \sum_{i=1}^N \pi'_i(e) (\alpha^{1/2} p_i^{-1/2\beta} - s_i \alpha p_i^{-\beta}) \\
&+ \lambda \left\{ \sum_{i=1}^N \pi'_i(e) [\alpha p_i^{-\beta+1} + s_i \alpha p_i^{-\beta} - v_i e_i^2] - 2v_i e_i \pi_i(e) \right\} = 0
\end{aligned}$$

$$(12) \quad \frac{\partial \mathcal{L}}{\partial s_i} = -\alpha p_i^{-\beta} \sum_{i=1}^N \pi_i(e) + \lambda \sum_{i=1}^N \pi_i(e) \alpha p_i^{-\beta} = 0$$

$$\begin{aligned}
(13) \quad \frac{\partial \mathcal{L}}{\partial p} &= \left[ -\frac{1}{2} \alpha^{1/2} p_i^{-1/2\beta-1} + \beta s_i \alpha p_i^{-\beta-1} \right] \sum_{i=1}^N \pi_i(e) \\
&+ \lambda \left\{ \sum_{i=1}^N \pi_i(e) [ -(\beta+1) \alpha p_i^{-\beta} - \beta \alpha s_i p_i^{-\beta-1} ] \right\} = 0
\end{aligned}$$

From (12) we can observe that the Lagrange multiplier  $\lambda = 1$  indicating that the optimal rate is utility increases by one unit as the constraint (9) is relaxed. Using that result ( $\lambda = 1$ ) the optimal subsidy  $s^*$  from (13) is then

$$(14) \quad s_i^* = \frac{\frac{1}{2} \alpha^{1/2} p_i^{1/2\beta} - (\beta+1) \alpha p_i}{\beta} \geq 0 \text{ if } 0 < \beta < 1 \text{ and } \alpha \text{ is large enough}$$

The optimal subsidy is positive more probably if the price elasticity of theatre performances is inelastic. This result is in line with Prieto-Rodríguez and Fernández-Blanco (2006). Moreover, a more inelastic

demand results in higher optimal public subsidy. Indeed most empirical studies report that the price elasticity fall into inelastic region (Seaman 2006,425). Various explanations have been presented to explain why most studies report inelastic demand. Among these, (Thorsby 1994) argues that the arts should have a low price elasticity since the qualitative characteristics are probably decisive. Therefore, the demand for art performances is inherently price insensitive. Another point is that ticket price does not reflect the full price since the opportunity cost of time is not taken into account.

The result above (14) gives a new explanation why the demand is inelastic. Optimal state subsidies are positive only if the demand is inelastic. Using a Finnish data covering 58 theatres (subsidised by law) during a five-year period from 2007 to 2011 reveals that the price elasticity of theatre performances is inelastic (Table 1 below). The data includes national opera and some dance theatres while the majority are drama theatres. All theatres in the data received subsidies from the state and most also from local municipalities. The share of overall subsidies is approximately 60 - 70 percent of all incomes of these theatres. A very simple panel data regression analysis shows that the demand is indeed price inelastic. The variable to be explained in the logarithm of tickets sold.

	Fixed effects model (FEM)	Random effects model (REM)
Log Average Price	-0.380*** (0.067)	-0.172** (0.058)
Log Performances/year	0.679*** (0.101)	0.936*** (0.079)
Constant		5.728*** (0.451)
	R <sup>2</sup> = 0.461	R <sup>2</sup> = 0.938
	Log likelihood	R <sup>2</sup>
Constant term only (1)	-375.650	0.00
Group effects only (2)	-19.941	0.913
X - variables only (3)	-245.762	0.591
X and group effects (4)	27.594	0.938
	Likelihood ratio test, $\chi^2$	F-test
(2) vs. (1)	711.418***	43.246***
(3) vs. (1)	259.776***	207.966***
(4) vs. (1)	806.491***	59.002***
(4) vs. (2)	95.073***	44.616***

(4) vs. (3)	546.715***	22.547***
REM vs. (3)	301.61***	
FEM vs. REM (Hausman)	40.41***	

Table 1: Demand equation:  $\text{Log}(\text{tickets sold}/\text{year}) = \text{Constant} + \beta \text{Log}(\text{average price}) + \gamma \text{Log}(\text{Performances}/\text{year})$ , Fixed effects and Random effects models. Standard errors in parenthesis

High values of the Hausman test favours fixed effects model indicating that the omitted effects (variables) are correlated with the included variables. The simple model leaves out for example the spectators' incomes.

Recalling that  $n_i = \alpha p_i^{-\beta}$  the optimal subsidy  $s_i^*$  is

$$(15) \quad s_i^* = \frac{\frac{1}{2}n^{1/2} - \alpha(\beta + 1) \left[\frac{n}{\alpha}\right]^{-1/\beta}}{\beta}$$

The optimal subsidy increases with the number of visitors  $n$  but with a diminishing rate.

If the subsidy is positive, an increase in the number of visitors increases also optimal subsidies but less than proportionally indicating that the share of public subsidies should be lower in larger towns where the potential for theatre visits is higher due to a larger population. Using the same data, the above hypothesis is studied. The share of public subsidies of all income is regressed with the number of tickets sold and three dummies due to special subsidies to opera or theatres to Swedish speaking minority. The dance theatres are separated with a dummy. The results show that indeed the subsidies indeed diminish as the number of tickets sold increases or if the population in the area is higher. Both the pooled regression (OLS) and random effects model (REM) results are presented in table 2 below.

The random effects model is formulated as follows:

$$(16) \quad s_{it} = \text{constant} + x'_{it}\beta + u_i + \varepsilon_{it}$$

where  $u_i$  is a theatre specific ( $n = 58$ ) random element. The results in table 2 show that the random effects models are preferred over pooled regression models based on the Lagrange multiplier test. In the random effects models the dummy variables for Swedish speaking (Svenska) drama theatres or dance theatres or opera are not significant since the theatre specific random element captures the effect.

The estimated (log) share of public subsidies models				
	OLS	REM	OLS	REM
Log Sold Tickets	-0.112*** (0.020)	-0.109*** (0.016)		
Log Population			-0.100*** (0.018)	-0.084* (0.038)
Svenska	0.075 (0.064)	0.076 (0.138)	0.237*** (0.066)	0.219 (0.144)
Dance	-0.095* (0.044)	-0.093 (0.090)	0.057 (0.042)	0.047 (0.092)
Opera	0.373** (0.128)	0.368 (0.269)	0.316* (0.126)	0.292 (0.272)
Constant	0.778*** (0.215)	0.752*** (0.175)	0.899*** (0.232)	0.688 (0.500)
R <sup>2</sup>	0.098	0.111	0.102	0.112
F	8.92***		9.23***	
Lagrange Multiplier test: REM vs. OLS		491.40		475.66

*Table 2: OLS and REM estimation results: 58 theatres, 5 years, standard errors in parenthesis*

The results indicate that the share of public subsidies is diminishing in population or in sold tickets. Theatres in more rural locations seem to receive relatively more public subsidies. The result is in line with studies showing that higher public funding is positively related to the number of productions a theatre mounts and negatively related to the conventionality of theatre programs (Austen-Smith 1980, DiMaggio & Stenberg 1985, O'Hagan & Neligan 2005, Werck et al. 2008) because conventional theatre repertoire is appealing to the audience.

## Conclusions

The principal-agent model presented proposes that the theatre managers should use a ticket price that lies in the inelastic segment of the demand curve. Using Finnish data covering 58 theatres that receive permanent public subsidies (subsidised by the law) we can show that the demand is indeed price inelastic. The model also suggests that the share of public subsidies is diminishing in the number of tickets sold. This result is verified using the data. The inelasticity of theatre performance demand has

been frequently presented in various studies (Seaman 2006). The principal-agent model here presents a justification for the observed price inelasticity. The standard monopoly model leading to equilibrium  $p = \frac{MC}{1 + \frac{1}{\epsilon}}$  indicates that we should have price elastic behaviour ( $\epsilon < -1$ ) which is not true if we have public subsidies.

A larger budget partially financed by the public subsidies typically leads to higher cost and bigger audience. The results of the principal-agent model and empirical evidence presented in tables 1 and 2 indicate that bigger audience is correlated with inelastic demand. In Finland, most towns have only one theatre house, which is a local monopoly, but the behaviour of the theatre house is not to set prices above costs due to public subsidies. Therefore, we do not observe price elastic behaviour. Another question is whether the subsidy scheme is optimal or not, since the full time equivalent person years is currently used as criteria for public subsidies. Alternatively, the subsidies could be related to number of tickets sold.

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