

Modelling preferences heterogeneity for performing arts: evidence from Perm Opera and Ballet Theatre

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Perm Opera and Ballet Theatre

- ▲ One of Russia's oldest theatres (Foundation in 1870).
- ▲ The theater has won the variety of awards (Golden Masks).
- ▲ The theatre is organizer of the International Diaghilev Festival and the Ekaterina Maximova Arabesque Ballet Competition.
- ▲ Since 2011 Teodor Currentzis is the theatre's Artistic Director.

Assumptions for Research Question

- ▲ The theater is nonprofit.
- ▲ The goal is to attract the residents to cultural life.
- ▲ The revenue from performances should cover at least 10% of expenditures.
- ▲ Objective function: maximization of revenue or maximization of attendance?
- ▲ The seats in a house are heterogeneous (price, quality of view, sound, prestige).
- ▲ The seats in the same area are considered as homogeneous.
- ▲ Consumer demands for a particular seat (seating area), not only for performance.

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Objective

Estimation of demand function for performing arts.

Research Question

Do the effects of a price and characteristics vary across the performances and the seats in a house?

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Studies on stated preferences

- ▲ Consumer preferences (Bille-Hansen, 1997);
- ▲ Utility function (Grisolia & Willis, 2012);
- ▲ Consumer surplus (Train, 2003);
- ▲ Willingness to pay (Levy-Garboua & Montmarquette, 1996);
- ▲ Patron (Baumol & Bowen, 1966).

Studies on revealed preferences

- ▲ Price elasticity of demand (Moore, 1966; Throsby & Withers, 1979);
- ▲ Income elasticity of demand (Greckel & Felton, 1987; Felton, 1994);
- ▲ Cross price elasticity of demand (Withers, 1980; Gapinski, 1984);
- ▲ The effect of quality (Throsby, 1983; Corning & Levy, 2002).

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- ▲ Data Source: Sales System of Perm Opera and Ballet Theatre
- ▲ 4 seasons (2011-2012/2014-2015)
- ▲ 985 performances
- ▲ 170 unique productions
- ▲ 680000 sales operations

Data Description

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- ▲ The name of performance;
- ▲ time: season, year, month, day of week, hour;
- ▲ the basic price of a ticket;
- ▲ the sector (loge, the stalls, tiered stalls, circle, upper circle);
- ▲ row and seat;
- ▲ seating area.

Scheme of a house



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Data description. Characteristics of performances

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- ▲ Type of performance (opera/ballet);
- ▲ the date of writing (classical/modern);
- ▲ the author (the rating, the nationality);
- ▲ the world rating of production;
- ▲ the date of premiere in a theatre;
- ▲ the duration of performance;
- ▲ the director and band director of production;
- ▲ chorus-master/ballet-master;
- ▲ the number of awards;
- ▲ age recommended for attendance.

Descriptive statistics: performance characteristics

	Variable	Obs	Share
Introduction	Type of performance	2682	
Literature	Ballet	954	36.6
Review	Opera	1728	64.4
Data	The date of writing	4257	
Methodology	Before 1990	2304	54.1
	1990 and later on	1953	48.9
Results	Recommended age group	2682	
Robustness	From 0	1107	41.3
Check	From 12	1170	43.6
	From 16	405	15.1
Summary	The presence of nomination in Golden Mask	4257	
	Presence	2061	48.4
	Absence	2196	51.6
	The presence of winning in Golden Mask	4257	
	Presence	1719	40.4
	Absence	2538	59.6
	The author's nationality	4257	
	Russian	1521	35.7
	Other	2736	64.3

Descriptive statistics: performance characteristics

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Variable	Description	Obs	Mean	St.dev.	Min	Max
Length	Length in minutes	1971	152.9	46.60	60	230
Antracts	The number of antracts	1971	1.60	0.6	1	3
Acts	The number of acts	2268	2.7	0.66	1	4
Rating of opera	1/(rating of opera)	2682	0.08	0.22	0.01	1
Rating of composer	1/(rating of composer)	2682	0.09	0.21	0.01	1
Rating of ballet	1/(rating of ballet)	2682	0.09	0.22	0.01	1

Descriptive statistics: price

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Variable	Obs	Mean	St.dev.	Min	Max
Basic price	4257	412	381	100	2000
Basic price (area1)	473	903.4	503.2	300	2000
Basic price (area2)	473	619.8	655.1	250	1400
Basic price (area3)	473	525.2	364.8	210	1300
Basic price (area4)	473	462.1	336.9	180	1200
Basic price (area5)	473	378.1	278.3	160	1000
Basic price (area6)	473	299.4	222.2	140	800
Basic price (area7)	473	239.9	158.6	120	600
Basic price (area8)	473	180.4	94.5	110	400
Basic price (area9)	473	100	0	100	100

Descriptive statistics: attendance rate

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Variable	Obs	Mean	St.dev.	Min	Max
Attendance rate	4257	0.80	0.25	0	1
Attendance (area1)	473	0.85	0.16	0.11	1
Attendance (area2)	473	0.89	0.14	0.35	1
Attendance (area3)	473	0.89	0.15	0.35	1
Attendance (area4)	473	0.90	0.15	0.11	1
Attendance (area5)	473	0.84	0.21	0.11	1
Attendance (area6)	473	0.80	0.25	0.06	1
Attendance (area7)	473	0.70	0.32	0.02	1
Attendance (area8)	473	0.65	0.34	0	1
Attendance (area9)	473	0.72	0.31	0	1

Descriptive statistics: attendance rate

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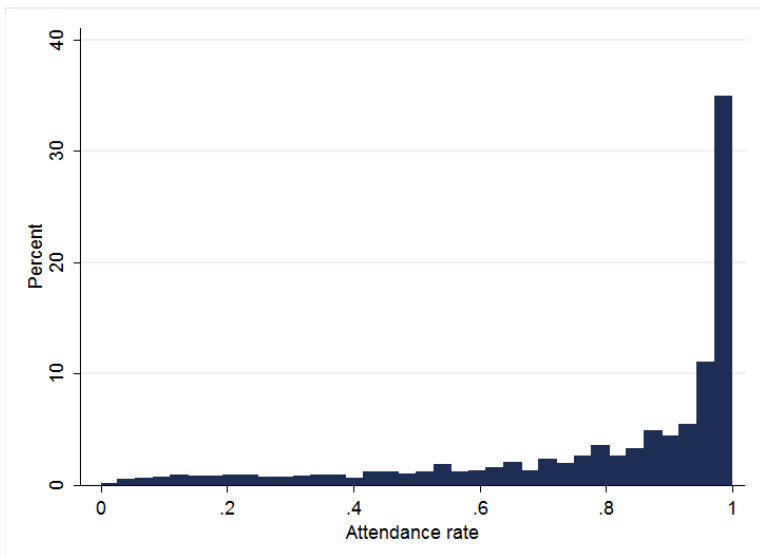
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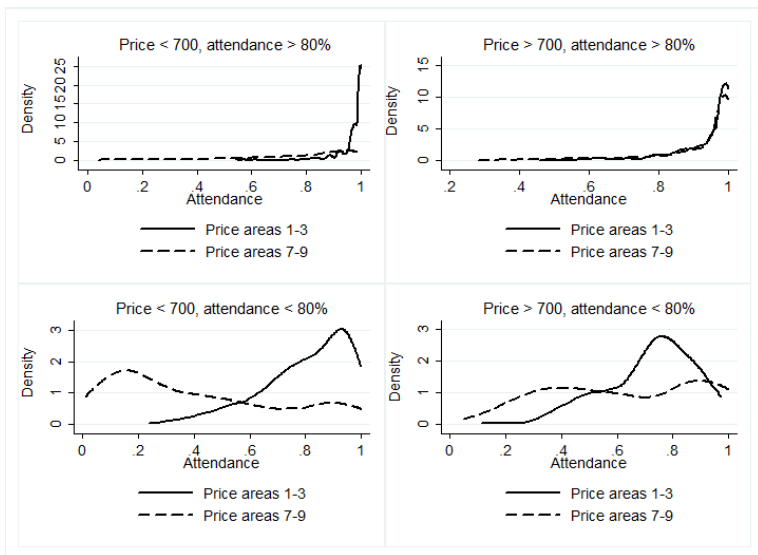
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Model of censored quantile regression (Chernozhukov & Hong, 2011):

$$Q_{y_{ij}^*|x_{ij},p_{ij}}(\alpha) = x_{ij}\beta(\alpha) + p_{ij}\gamma(\alpha),$$

$$Q_{y_{ij}|x_{ij},p_{ij}}(\alpha) = \begin{cases} Q_{y_{ij}^*|x_{ij},p_{ij}}(\alpha), & y_{ij}^* \leq 1 \\ 1, & y_{ij}^* > 1 \end{cases}, \quad (1)$$

where

y_{ij} is the observed demand on performance i in seating area j ;

y_{ij}^* is a potential demand on performance i in seating area j ;

$Q(\alpha)$ is a conditional quantile function of level α ;

α is a level of quantile, $\alpha \in [0..1]$;

p_{ij} is the price of a ticket on performance i in a j -th seating area;

x_{ij} are the characteristics of performance i in a j -th seating area.

Estimation procedure

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Step 1. Estimation of probability to be censored for each observation

$$\hat{P}_{ij} = E[Prob(y_{ij} > 1) | x_{ij}, p_{ij}], \forall (ij)$$

Step 2. Estimation of model on the sample J_0

$$\check{y}_{ij} = Q_{y_{ij}|x_{ij}, p_{ij}}(\alpha), \text{ where } (ij) \in J_0$$

$$J_0 = \{(ij) | \hat{P}_{ij} \leq F_{0.9}^{-1}(\hat{P}_{ij} < (1 - \alpha))\}$$

Step 3. Final estimation of model on the sample J_1

$$\hat{y}_{ij} = Q_{y_{ij}|x_{ij}, p_{ij}}(\alpha), \text{ where } (ij) \in J_1$$

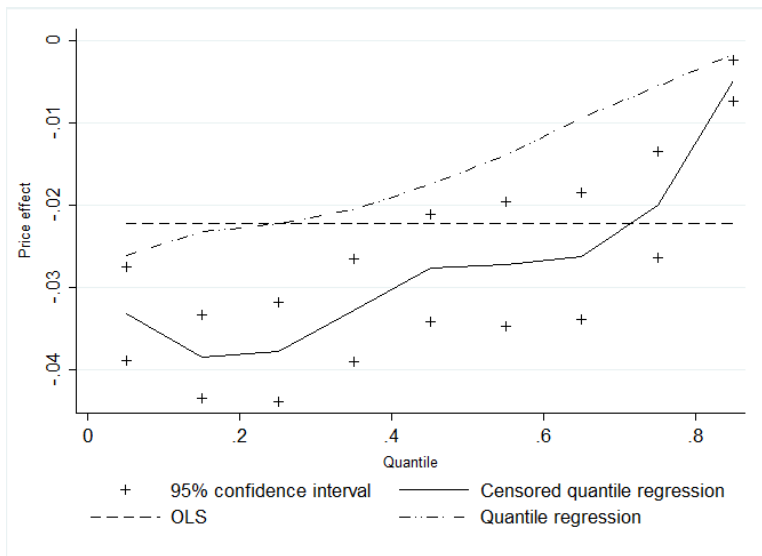
$$J_1 = \{(ij) | \check{y}_{ij} \leq F_{0.97}^{-1}(\check{y}_{ij} \leq 1)\}$$

Results. Regressions

Variable	OLS	Median regression	Censored median regression
Basic price/100	-0.022*** (0.002)	-0.015*** (0.003)	-0.028*** (0.004)
The russian author	0.060*** (0.010)	0.052*** (0.017)	0.090*** (0.018)
Premier	0.110*** (0.014)	0.112*** (0.023)	0.154*** (0.026)
Rating of opera	0.034 (0.027)	0.068 (0.044)	0.020 (0.044)
Rating of ballet	0.107*** (0.023)	0.072* (0.038)	0.252*** (0.054)
Type: Ballet	0.333*** (0.013)	0.257*** (0.021)	0.414*** (0.024)
Number of awards in GM	0.045*** (0.011)	0.053*** (0.019)	0.059*** (0.020)
Band director T.Currentzis	0.039** (0.019)	0.020 (0.031)	0.054* (0.032)
Recommended age: from 12 y.o.	0.039*** (0.011)	0.007 (0.018)	0.043** (0.019)
Recommended age: from 16 y.o.	-0.078*** (0.018)	-0.128*** (0.030)	-0.098*** (0.030)
The time of day: evening	-0.028** (0.014)	-0.010 (0.023)	-0.026 (0.026)
Constant	0.793*** (0.025)	0.813*** (0.041)	0.847*** (0.047)
Number of observations	2682	2682	2105
Number of parameters	35	35	35
R^2	0.467	-	-

Results. Comparison of marginal effects

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Results. Censored quantile regression on different quantiles

Variable	$\alpha=0.2$	$\alpha=0.4$	$\alpha=0.6$	$\alpha=0.8$
Basic price/100	-0.036*** (0.003)	-0.031*** (0.003)	-0.026*** (0.004)	-0.012*** (0.002)
The russian author	0.104*** (0.016)	0.107*** (0.016)	0.086*** (0.020)	0.046*** (0.011)
Premier	0.182*** (0.022)	0.174*** (0.023)	0.135*** (0.029)	0.056*** (0.017)
Rating of opera	0.105*** (0.040)	0.071* (0.040)	0.018 (0.049)	0.013 (0.029)
Rating of ballet	0.267*** (0.045)	0.195*** (0.046)	0.233*** (0.060)	0.157*** (0.049)
Type: Ballet	0.533*** (0.021)	0.466*** (0.022)	0.363*** (0.028)	0.135*** (0.015)
The number of awards in GM	0.063*** (0.017)	0.074*** (0.017)	0.030 (0.021)	0.015 (0.016)
Band director T. Currentzis	0.009 (0.029)	0.036 (0.029)	0.008 (0.035)	-0.004 (0.021)
Recommended age: from 12 y.o.	0.049*** (0.017)	0.038** (0.017)	0.048** (0.022)	0.017 (0.012)
Recommended age: from 16 y.o.	-0.095*** (0.027)	-0.117*** (0.027)	-0.046 (0.033)	-0.030 (0.019)
The time of day: evening	-0.068*** (0.022)	-0.018 (0.023)	-0.018 (0.029)	-0.003 (0.016)
Constant	0.674*** (0.040)	0.795*** (0.042)	0.891*** (0.053)	0.973*** (0.029)
Number of observations	2343	2170	2008	1985
Number of parameters	35	35	35	35

Endogeneity of Price

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- ▲ Possible correlation between unobservable performance quality and price
- ▲ The variation of price within the performance as an instrument for the price (Hausman & Taylor, 1981)
- ▲ Two-step estimation procedure (Chernozhukov, Kowalski & Fernandez-Val, 2015)
 - ▶ Regression of price on within price and performance characteristics
 - ▶ Regression of attendance rate on price, performance characteristics and residuals

Endogeneity of Price. Estimation

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Step 1. Regression of price on within price and performance characteristics

$\hat{p}_{ijk} = Q_{p_{ijk}|\tilde{p}_{ijk}, x_{ijk}}(\alpha)$, where $\tilde{p}_{ijk} = p_{ijk} - \bar{p}_{.jk}$

$\hat{e}_{ijk} = p_{ijk} - \hat{p}_{ijk}$ - residuals

p_{ijk} - the price on play i in seating area j for performance k

\tilde{p}_{ijk} - price within, an instrument for p_{ijk} ,

$\bar{p}_{.jk}$ - the average price over plays on performance k in seating area j .

Step 2. Regression of attendance rate on price, performance characteristics and residuals from the first step

$\hat{y}_{ijk} = Q_{y_{ijk}|p_{ijk}, x_{ijk}, \hat{e}_{ijk}}(\alpha)$

Endogeneity of Price. Results

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	$\alpha=0.3$	$\alpha=0.3$	$\alpha=0.5$	$\alpha=0.5$	$\alpha=0.7$	$\alpha=0.7$
	CQIV	CQR	CQIV	CQR	CQIV	CQR
Basic price	-0.041*** (0.003)	-0.040*** (0.003)	-0.038*** (0.004)	-0.037*** (0.004)	-0.031*** (0.004)	-0.030*** (0.004)
$\hat{\epsilon}$	-0.000 (0.000)	-	0.000 (0.000)	-	0.000 (0.000)	-
N	1931	2221	1737	1998	1563	1798
K	35	35	35	35	35	35

Note: standard errors are in parenthesis. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. In the model we also include as control variables: the nationality of author, the rating and type of performance, the premier year, the band director, the recommended age, the time of day, the number of Golden Mask, the year and month of play and seating area dummies.

Summary of Results

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Summary

- ▲ The necessity to employ the quantile regression
- ▲ The necessity to account for demand censoring
- ▲ Consumers are elastic by price on average
- ▲ Price elasticity is decreasing with the quantile in absolute values
- ▲ Robustness check has revealed an absence of endogeneity problem.