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Estimating demand functions with average prices: does it impose endogeneity?

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Abstract:

Demand functions are sometimes estimated using average prices, i.e., total revenue divided by the number of consumers, due to a lack of information about the prices faced by consumers. Examples of this type of estimation can be found for cinema, sporting events and the performing arts, since box office revenue is frequently available. We construct a straightforward theoretical model showing that this practice introduces a major source of endogeneity into empirical research. Moreover, this sort of endogeneity might also appear in any demand study where four conditions are satisfied: the demand function is defined for an entire territory; there are regional differences in prices; these prices are not available and hence an overall (e.g. national) price is used; and this price measure can be viewed as a weighted average of regional prices where the weights are the share of each region in total demand. An empirical application is provided using Spanish data on cinema attendance to illustrate the validity of the strategy proposed here to address this sort of endogeneity in an instrumental variable framework.

Keywords: Average price; demand estimation; endogeneity; instrumental variables

JEL classification: C13, Z10

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1. Introduction

A traditional strand of the literature in empirical economics relies on the estimation of demand functions using either individual or market data. It often happens in these settings, however, that we are forced to use average prices due to a lack of information regarding the actual prices faced by buyers. This is, for instance, a common problem in cultural and sport economics where box office revenue is frequently available and, hence, total revenue divided by the number of customers is used as a proxy for output prices.

The main aim of this paper is to highlight the endogeneity problems that appear when average prices are used to estimate demand functions. In particular, a straightforward theoretical model is constructed that demonstrates that the aforementioned lack of information regarding the prices and the need of using average prices introduce endogeneity problems in the estimation, even when original prices are not endogenous by nature. Hence, the traditional ordinal least squares estimator is inconsistent and an appropriate instrumental variables estimator should be used to consistently estimate the main coefficients of the demand function. We also explore how to identify appropriate instruments when individual prices are not available. Although this is not the first attempt using instrumental variable to estimate demand functions, we believe that this paper will help to clarify an important source of endogeneity when researchers have to use average prices. In this sense, we show that the endogeneity problem is associated with price differences within and between sellers, and hence the best candidates for good instruments are variables that are roughly common to all sellers but associated with the average price.

The movie market is an ideal setting to illustrate our model because average prices (movie revenue divided by its number of attendants) must be used, since there is no available information about the actual prices paid by cinema attendants. We are aware that other determinants of cinema attendance might be also endogenous,[1] but we

[1] In particular, Elberse and Eliashberg (2003) pointed out that the number of screens might be endogenous. However, as it is explained later on, this endogeneity problem is not severe when the number of screens in the opening week is included in the cinema demand (revenue) function,

provide an empirical application using Spanish data on cinema attendance just to explore how the suggested instruments allow us to address, the aforementioned endogeneity problem in prices in an instrumental variable framework.We have tested our model using the Spanish movie market, and our results confirm that average prices are endogenous. Therefore, this problem must be dealt with by redefining the empirical demand model using instrumental variables estimators.

Moreover, it is worthy to note that the source of price endogeneity discussed in this paper might appear, not only in cinema demand studies, but also in any demand study where four conditions are satisfied: (i) the demand function is defined for an entire territory (e.g. a country); (ii) there is no unique price for the whole territory, i.e. there are significant regional or local differences in prices; (iii) regional prices are not available and hence an overall (e.g. national) price is used; and (iv) this price measure can be viewed as a weighted average of regional prices where the weights are the share of each region in total demand. This is the situation in this cinema application. We have the overall attendance to a particular film in Spain. Cinemagoers pay different prices in each region. The regional price is not observed and an average price is computed from (overall) box office revenues and (overall) attendance. In the methodological section it is shown that this price variable is a weighted average of each regional price. Since the weights are regional shares in total demand, this introduces endogeneity problems in the estimation.

Papers analysing cinema demand functions are becoming more frequent in recent years. Some research estimating national cinema demand functions may be found. British cinema attendance is the most analysed in these papers (Cameron 1986, 1988, 1990, 1999; McMillan and Smith 2001; Hand 2002) but cinema demand functions have also been estimated for Spain (Fernández-Blanco and Baños-Pino 1997), United States (Canterbery and Marvasti 2001), Italy (Bagella and Becchetti 1999), Germany (Dewenter and Westerman 2005) and a pool of thirteen European countries (Sisto and Zanola 2004). Most of these studies use aggregated data like annual total attendance or box office revenues in each country, but estimations of demand functions using data

coming from each released film, such as that included in the present paper, are less frequent.[2]

The article is structured as follows. In the next section, the basic modelling framework is presented, along with the theoretical reasons that average prices introduce endogeneity. In Section 3, the principal results of the illustration are presented. The final section offers concluding remarks.

2. Theoretical framework

As mentioned above, in many empirical papers on cultural and sport economics, admission prices are usually defined as average ticket prices due to limited data. This was the procedure used in Fernández-Blanco and Baños-Pino (1997) and Vogel (2007) for estimating movie demand, in Akdede and King (2006) and Werck and Heyndels (2007) for theatre and in Dobson and Godard (2001) for sporting events.

Next it is demonstrated that using average prices introduces a major source of endogeneity into empirical research as Dewenter and Westerman (2005) and Garcia and Rodriguez (2001) have suspected and solved for cinema and football demand, respectively. The aim of this paper is to examine the nature of this endogeneity problem in order to find valid instruments for estimating demand. It should be noted that there are other reasons why price could be endogenous and there are multiple examples in economic literature on this issue, some of reasons are related to the lack of competition in the markets. Nevertheless, this kind of argument is uncommon in cultural economics even when the markets of cultural industries are not perfectly competitive. Cinema seems to be a very particular market where exhibitors (in accordance with distributors and producers) do not compete in prices.[3] In fact, ticket prices are very similar within

[2] Moreover, there are some papers analysing the effect of some quality features like genre, budget, critics, etc. on film attendance (Hadida 2009, provides a wide survey of this research) and, from the point of view of industrial organization, some demand models have been estimated to discuss different issues such as spatial competition (Davis 2006), seasonality (Einav 2007), or pricing policy (Orbach and Einav 2007).

[3] Orbach and Einav (2007) give some reasons for this policy.

each local market and some attempts to establish more flexible price systems have been boycotted by the industry (e.g. EasyCinema fixed prices depending on demand and timing at its Milton Keynes theatre but had to face many restrictions to exhibit new released films and finally they closed down in 2006). Hence, ticket prices could be considered exogenous for each movie at different local markets. [4]

To explain the origin of the endogeneity problem the following theoretical model is proposed.

Let us assume that films or plays are only displayed by N independent sellers and, for purposes of simplification, that each seller has only one type of ticket. Next, let us write the attendance (i.e., total sold tickets) for a particular event *i* at venue *j* as follows:

$$q_{ij} = a_i + b\ P_j + \varepsilon_{ij} \tag{2}$$

a_i is a function of the movie or play characteristics, b is a parameter to be estimated, P_j is the ticket price in venue j and ε_{ij} is a random term. If the ticket price at venue j is fixed, it can be assumed to be exogenous, that is, $\text{cov}(P_j,\varepsilon_{ij}) = 0$.

The aggregate demand function for a particular film (play) can be obtained by summing up the demand for all venues. If we assume that there are only two venues, the aggregate demand for a particular film (play) can be written as:

$$Q_i = q_{i1} + q_{i2} = (a_i + b P_1 + \varepsilon_{i1}) + (a_i + b P_2 + \varepsilon_{i2}) = 2a_i + 2b\left(\frac{P_1 + P_2}{2}\right) + (\varepsilon_{i1} + \varepsilon_{i2}) = \alpha_i + \beta P + \eta_i, \tag{3}$$

where $\beta=2b$; $\alpha_i=2a_i$; $P=(P_1+P_2)/2$ is the average price and $\eta_i=(\varepsilon_{i1} + \varepsilon_{i2})$ is the random term. Note that P_1 and P_2 are uncorrelated with ε_{i1} and ε_{i2} by construction and, therefore, $\text{E}[\eta_i \mid P]=0$ if $\text{E}[\varepsilon_{i1}]=\text{E}[\varepsilon_{i2}]=0$. This, however, is simply the assumption of strict exogeneity in the classical regression model for P.[5] The Law of Total Expectations

[4] However, ticket prices might not be considered completely fixed since theatres may have some promotions for special consumers (students, older people, etc.) or at specific days or hours.
[5] See, for instance, Hayashi (2000, p. 7).

and the strict exogeneity assumption implies that cov(P, η_i)=0, i.e., strict exogeneity implies that the regressors are uncorrelated with the error term.

In order to estimate equation (3), information about P_1 and P_2 is required. However, quite often, information about the ticket prices in all the theatres or sporting venues, along with the prices that consumers actually pay, is not available. Consequently, researchers often replace P with the average price paid by the attendants of event i, B_i, which is constructed by dividing i's total box-office revenue by the aggregate demand. In this case, that is:

$$B_i = \frac{P_1 q_{i1} + P_2 q_{i2}}{Q_i} = P_1 s_{i1} + P_2 s_{i2}, \qquad (4)$$

where $s_{ij}=q_{ij}/Q_i$ is the share of seller j for event i's total demand. That is, B_i is a weighted average price, where the weights are the shares of each theatre or venue in the total demand. Notice that shares differ according to spectacle, since q_{ij} has a stochastic term. Therefore, the average price varies according to movie, play or sporting event, even if prices are fixed by venue.

It is easy to show that even if P is orthogonal to the error term, the average price is endogenous. The endogenous nature of B_i comes from the suppliers' shares, which are functions of the error terms ε_{i1} and ε_{i2}. Indeed, by substituting equations (2) and (3) in (4) we get:

$$B_i = \frac{P_1(a_i + bP_1 + \varepsilon_{i1}) + P_2(a_i + bP_2 + \varepsilon_{i2})}{2a_i + 2b\,P + (\varepsilon_{i1} + \varepsilon_{i2})} = \frac{2a_i P + b(P_1^2 + P_2^2) + P_1\varepsilon_{i1} + P_2\varepsilon_{i2}}{2a_i + 2b\,P + (\varepsilon_{i1} + \varepsilon_{i2})}. \qquad (5)$$

Therefore, B_i depends on error terms ε_1 and $\varepsilon_{2,}$. This equation shows that the average price, B_i, is not exogenous, and hence the traditional least squares estimators will yield biased and inconsistent estimates if we use average prices as proxies of P. It is important to note that the problem is not the stochasticity or exogeneity of individual prices but the way the measure is constructed. If the (implicit) weights are not strictly exogenous, an endogeneity problem may be generated, even though this problem does not emerge when exhibitors' prices are exogenous.

If we are forced to use an average price (B_i), let us consider the conditions under which the aforementioned endogeneity problem might vanish. From (5) we see that the stochastic nature of B_i disappears when all sellers fix the same prices (i.e., $P_1=P_2$) or all exhibitors have the same market share. In other words, the endogeneity problem is associated with differences in prices among sellers. The higher the price dispersion among sellers, the higher the endogeneity problem if only average price is available.

Since the endogeneity problem is associated with differences in prices among sellers, the best candidates for good instruments are variables that do not vary over sellers but are correlated with the average ticket prices paid by costumers all around. For example, if we want to estimate movie demands, the release date, as a continuous variable, is roughly common to all exhibitors, but it is associated with the average price because ticket prices are increasing over time. For the same reasons, other valid instruments can be the consumption price index or a polynomial function of a time trend.

3. Data and model

An original data set has been constructed containing information on 356 pictures released from 2003 through 2005 in Spain.[6] Each year , only the films with certain box office success have been selected. This group of movies is only 22.11% of the total movies released in Spain in these three years, but they represent 83.11% of the total box office and 80.55% of total attendees. By nationality, 58.27% are American, 29.54% are Spanish and 13.19% are from other countries (see Table 1).

[6] Although our data base period is 2003-2005, it includes however, some pictures released at the end of 2002 because they had notorious revenues in 2003.

Table 1. Description of the sample

	2003		2004		2005	
		% over total (by group)		% over total (by group)		% over total (by group)
MOVIES RELEASED	134	25.43	129	25.10	93	16.34
Spanish Movies*	45	41.67	53	45.30	11	8.59
American Movies	74	31.90	67	29.65	61	37.75
Movies from Other Countires	15	8.02	9	5.26	21	7.64
REVENUES (million €)	**555.57**	**86.89**	**540.01**	**78.08**	**495.09**	**77.97**
Spanish Movies*	88.92	88.16	87.07	93.75	44.04	41.46
American Movies	377.57	87.81	382.27	79.26	353.32	92.53
Movies from Other Countires	89.09	82.02	73.64	63.22	97.73	66.54
ATTENDANCE (million people)	**119.00**	**86.56**	**112.70**	**78.30**	**88.82**	**69.58**
Spanish Movies*	19.08	87.80	17.34	89.92	8.71	40.91
American Movies	81.05	87.66	80.05	79.75	60.73	78.91
Movies from Other Countires	18.87	81.06	15.30	63.07	19.37	65.88

Source: Spain's Ministry of Culture, own calculations
* Including co productions

The Spanish Ministry of Culture (SMC, www.mcu.es/cine) has been the main source of information for building this database. In particular, information about box office and qualitative features of films comes from *Instituto de la Cinematografía* y *las Artes Audiovisuales* (ICAA) which belonged to the Spanish Ministry of Culture. The release dates in Spain and some qualitative variables such as international and national awards come from *Cine por la Red* (CPR, www.porlared.com) and the *Internet Movie Data Base* (www.imdb.com).

The empirical model to be estimated is represented by the demand equation for a particular movie *i*. Assuming multiple exhibitors, the demand function in logarithm terms is:

$$\ln ATTENDANCE_i = g(B_i, X_i, \varepsilon_i) = \alpha + \beta \ln PRICE_i + \gamma X_i + \eta_i, \qquad (6)$$

where α, β and γ are the set of parameters to be estimated, η_i is the error term, and X_i is a vector of movie characteristics that can affect demand.

We have estimated the cinema demand function (6) using the traditional set of explanatory variables employed in previous demand studies in the movie industry. In particular, we have used the total number of tickets sold as a measure of the attendance to a particular film. As is customary in other applications, it is necessary to use the average ticket price paid by consumers (LN*PRICE*) as the relevant price determinant in the demand function. This variable is defined as the total box-office revenues divided by the number of attendants, and, due to the reasons pointed out in the previous section, it is endogenous by construction. Therefore, we expect the coefficient of this variable to be largely biased. This coefficient thus intended to provide clues regarding the existence of endogeneity problems when using average prices in order to estimate demand functions.[7]

Following previous literature, we have also included other explanatory variables that can influence film attendance and have been analysed in several papers which Elberse and Eliashberg (2003) and Hadida (2009) have reviewed. In this sense, the number of releasing screens (LNSCREENS) and movie budget (LNBUDGET), have both been included in logarithms. The budget of a film is expected to have a positive effect on a film's attendance. This assumption seems tenable as larger resources allow to finance high quality inputs for technical equipment and other "below the line" inputs such expensive special effects, product design, or large advertising campaigns, as well as buying creative "above the line" inputs such as brand name screen writers, directors and actors (see, for instance, Prag and Casavant 1994). Regarding the number of screens in the opening week, it is included as an explanatory variable as it partially depends on the potencial attractivenes and quality of the released films. In addition, since the relevant geographic market in the movie theather industry is local in nature, (Davis 2006) it may also be viewed as an "inverse" measure of customer' transaction costs.

We have included three dummy variables to control for the effect of being awarded with some national or international prize. GOYA is a dummy variable that takes value 1 if the film was awarded in the most relevant categories of Spanish film awards (best

[7] In should be noted that the coefficients of other explanatory variables might be also biased due to the average price variable being endogenous.

movie, director, actor/actress, etc.). The dummy variable OSCAR is defined in a similar way, but with respect to the Oscar awards. Finally, FESTIVAL is a dummy variable that takes value 1 if the film was awarded with the first prize in one of the main International Film Festivals (Cannes, Berlin, Venice, San Sebastian). To control for the effect of ex-ante popularity of actors we have included two dummy variables. The first dummy variable is INT. STAR which takes value 1 if the film includes either an international star or an actor/actress or director Oscar awarded.[8] The second is NAT. STAR that takes value 1 if the film includes an international star or an actor/actress or director who has received a Goya award. [9]

A film's genre may also affect a film's attendance. Accordingly, several dummy variables (i.e. ADVENTURE, ACTION, THRILLER, COMEDY, CARTOON and DRAMA) are defined to capture this effect. Age restrictions or moral rating may also influence the success of a movie. These effects are, however, ambiguous as age restrictions reduce the number of viewers, but simultaneously they may signal specific contents of a film and can potentially increase the number of attendants. Dummy variables G and R have been included to control for this effect. They take value 1 if the film is suitable for all ages or just for people over 18, respectively.

Several dummy variables were set up to see if there is a relationship between a film's nationality and the film's performance. In particular, SPAIN, USA, UK, FRANCE and NEW ZEALAND take value 1 respectively if the film is Spanish, American, British, French or New Zealander. We also use the variable COPRODUCTION defined as the percentage of Spanish share in co-produced films, to see if there is a relationship between international co-productions and the film's attendance with Spanish audiences. Finally, previous research has shown a seasonal pattern in movie releases and box office performance.[10] Three dummy variables (FIRST QUARTER, SECOND QUARTER,

[8] We use two types of international stars because some actors, such as Tom Cruise, are famous but they have not been awarded with an Oscar.
[9] Note that popularity is only a measure of previous success and, therefore, not an objective and external measure of film's quality. The ex-ante popularity of an actor is rather a measure of the knowledge that consumers have about a particular actor. The superstar phenomenon exists, among other determinants, because individual utility increases with the individual knowledge about the work of a specific actor (Rosen 1981; Adler 1985).
[10] See, for instance, Litman (1983), Sochay (1994), Radas and Shugan (1998); and Einav (2007).

and THIRD QUARTER) are used to control for demand seasonality throughout the year.

Descriptive statistics for the model variables are presented in Table 2.

Table 2. Descriptive statistics

VARIABLE	MEAN	ST.DEVIATION	MIN	MAX
LN(ATTENDANCE)	13.1662	1.1129	10.3107	15.7254
LN(PRICE)	1.5712	0.1815	-0.7467	3.9313
LN(BUDGET)	9.8786	1.4755	5.5603	12.2405
LN(SCREENS)	5.2678	0.6807	2.7081	6.4019
OSCAR	0.1573	0.3646	0	1
GOYA	0.1152	0.3197	0	1
FESTIVAL	0.0225	0.1484	0	1
NAT. STAR	0.8427	0.3646	0	1
INT. STAR	0.4494	0.4981	0	1
G	0.2135	0.4103	0	1
R	0.2191	0.4142	0	1
AVENTURE	0.1292	0.3359	0	1
ACTION	0.1180	0.3230	0	1
THRILLER	0.1685	0.3749	0	1
COMEDY	0.2837	0.4514	0	1
CARTOON	0.0618	0.2411	0	1
DRAMA	0.2360	0.4252	0	1
SPAIN	0.1770	0.3822	0	1
USA	0.5674	0.4961	0	1
UK	0.0758	0.2651	0	1
FRANCE	0.0253	0.1572	0	1
NEW ZEALAND	0.0056	0.0748	0	1
COPRODUCTION	0.1292	0.3359	0	1
FIRST QUARTER	0.2388	0.4269	0	1
SECOND QUARTER	0.1826	0.3869	0	1
THIRD QUARTER	0.2669	0.4429	0	1

4. Empirical results

Table 3 presents the results of regression (6) using both OLS and IV estimators.[11] Let us begin with the parameter estimates of other film attendance determinants, which are quite similar using either an OLS or IV estimator. Later on, the results regarding the key premise of the study that using average prices (i.e. LN*PRICE*) introduce a major source of endogeneity into empirical research are discussed.

As expected, it is revealed that LNBUDGET is positively related to a Spanish film's performance in terms of admission numbers.[12] Furthermore, while total admissions rise with a film's budget, the elasticity is below one, indicating that a higher budget investment does not necessarily pay itself back. Like previous studies examining factors underlying box office success in the film industry, we find that the number of releasing screens (LNSCREENS) is one of the most critical factors affecting a film's performance.[13] Cinema demand in Spain also depends on awards since our three correspondent variables have positive and statistically significant coefficients.

On the other hand, while the *ex ante* popularity of national actors NAT.STAR does not have a significant effect on film attendance, the *ex ante* popularity of international actors INT.STAR has a significant effect on the performance of films. Thus, cinema demand in Spain depends on the presence of international, not national, stars. Considering genre types, none of the correspondent coefficients are statistically significant, and hence, each genre type performs similarly once we control for other

[11] For both estimators we reject the null hypothesis of no heteroskedasticity at the 1% percent level of significance using the Br./Pagan LM chi-squared test. Although accounting for heteroskedasticity does not produce significant changes in inference, we present hereafter the White heteroskedasticity-consistent t-ratios.

[12] It is plausible that there is some degree of collinearity between the independent variables. For instance, one might expect that high budgets and famous actors are positively related.

[13] Elberse and Eliashberg (2003) pointed out that because exhibitors might allocate screens based on their expectations regarding audience demand in a movie's opening week, and these expectations depend on past revenues (attendance), the number of screens in later weeks might be endogenous. However, the number of screens in the opening week might be considered endogenous because, in assessing a movie's quality in its opening week, potential audiences have to rely on external sources.

film characteristics. Moreover, moral rating has no significant influence in Spanish demand, reinforcing the ambiguous effect of age restrictions on the success of a movie,.

Our analysis fails to support the existence of temporal patterns over time.
With regard to nationality variables, the estimated coefficients offer some controversial outcomes. It is confirmed that Spanish moviegoers dislike Spanish movies and, unexpectedly, the same occurs with American films. To explain this fact it must be pointed out that, in our data base, American movies include not only blockbusters, but also non-successful films, that in some sense major distributors impose on the Spanish market. Finally, *The Lord of the Rings* justifies the positive effect of New Zealand. Finally, COPRODUCTION has a negative effect on cinema attendance in Spain, so the higher the Spanish presence on international projects, the worse their market performance.

Let us now go back to the key premise of the study, that is, that using average prices introduces a major source of endogeneity into empirical research, even when original prices are not endogenous by nature. The estimated coefficient for LN(PRICES) is positive and statistically significant for the Spanish market when Equation (6) by OLS is estimated. This violates the basic principles of demand theory. Hence, our first result confirms that OLS is not an adequate procedure for estimating cinema demand functions if average ticket price is included

Since average ticket prices are endogenous by definition, the IV estimators have been applied, using the release date as our instrument.[14] We have carried out several tests to check whether our model is identified and the proposed instrument is not weak. First, we reject the null hypothesis of no correlation between the release date and the endogenous regressor at the 1% level of significance using LM and Wald Kleibergen-Paap tests, which are valid under the presence of heteroskedastic errors. That is, our model is identified. Second, since weak identification might arise when the selected instruments are correlated with the endogenous regressors but only weakly, we test whether the release date is a weak instrument using the correspondingly robust Kleibergen-Paap Wald rk F statistic. We reject that the model is weakly identified at the

[14] We have measured the release date in a continuous form.

1% level of significance, and hence we can conclude that our IV model -that just uses the release date as instrument- is robust and performs sufficiently well.

IV regression provides better results than OLS as most of our previous hypotheses are confirmed (e.g., cinema demand in Spain depends strongly on the number of releasing screens and the film's budget), *and* the estimated coefficient for LN(PRICES) does not violate one of the basic principles of demand theory. Now, the estimated cinema demand is, as expected, decreasing in prices and slightly price-inelastic.

In summary, the empirical application included in the present paper allows us to illustrate the endogeneity problems that might appear when average prices are used to estimate demand functions. Our empirical results also support the validity of the instruments suggested in the theoretical section, i.e. since the endogeneity problem is associated with differences in prices among sellers, the best candidates for good instruments are variables that do not vary over sellers but are correlated with the average ticket prices paid by costumers all around.

Table 3 Estimation results

	OLS	2SLS(IV)
LN(PRICE)	0.1696	-0.9047
	(4.370)	(-2.244)
LN(BUDGET)	0.1960	0.1987
	(3.902)	(4.005)
LN(SCREENS)	1.0377	1.0319
	(8.326)	(8.293)
GOYA	0.6446	0.6490
	(5.382)	(5.752)
OSCAR	0.4231	0.4355
	(3.648)	(3.944)
FESTIVAL	0.3743	0.3901
	(1.902)	(2.177)
INT. STAR	0.1012	0.1145
	(1.857)	(2.098)
NAT. STAR	0.0296	0.0441
	(0.207)	(0.314)
AVENTURE	-0.3542	-0.3161
	(-1.176)	(-1.094)
ACTION	-0.3311	-0.2979
	(-1.061)	(-0.983)
THRILLER	-0.3244	-0.2458
	(-1.119)	(-0.865)
COMEDY	-0.0259	0.0045
	(-0.103)	(0.019)
CARTOON	-0.3771	-0.3187
	(-1.015)	(-0.848)
DRAMA	-0.0484	-0.0032
	(-0.183)	(-0.012)
G	0.1104	0.0609
	(1.451)	(0.720)
R	0.0827	0.1137
	(0.768)	(1.251)
SPAIN	-0.4076	-0.4214
	(-3.546)	(-3.846)
USA	-0.2425	-0.2476
	(-2.055)	(-2.233)
UK	-0.0099	0.0059
	(-0.085)	(0.057)
FRANCE	-0.2465	-0.2444
	(-2.960)	(-3.335)
NEW ZEALAND	0.4812	0.4222
	(2.885)	(2.536)
COPRODUCTION	-0.5540	-0.5315
	(-2.895)	(-2.982)
FIRST QUARTER	0.1052	0.0771
	(1.566)	(1.173)
SECOND QUARTER	0.0919	0.0506
	(0.759)	(0.419)
THIRD QUARTER	0.0246	-0.0082
	(0.217)	(-0.081)
CONSTANT	5.6549	7.3082
	(9.238)	(10.536)
N	356	356
R2	0.7326	0.7032

Note: T-statistic in brackets. Statistics robust to heteroskedasticity.

4. Conclusions

On several occasions, the unavailability of data has forced the estimation of demands using average price, defined as the ratio of revenues to customers. We have elaborated a theoretical model showing that this procedure creates an endogeneity problem between the proxy for prices and the dependent variable (the number of customers or attendance). Therefore, when researchers have to use average prices in order to estimate demand functions in any economic sector, they should be aware of an endogeneity problem and use instrumental variable estimators.

In general, this endogeneity problem might appear in any demand study if the demand function is defined for an entire territory (e.g. a country); there are regional (local) differences in prices; these prices are not available and hence an overall (e.g. national) price is used; and this price measure can be viewed as a weighted average of regional prices where the weights are the share of each region in total demand.

The endogeneity problem discussed in the present paper comes from differences in prices *between* sellers (regions) even if there are no *within* price differences. Thus, any variable that does not vary over sellers (regions) but is still correlated with the original prices is a candidate for a good instrument.

We have tried to illustrate our theoretical approach by estimating a movie demand function in Spain using a database that includes 356 films released in Spain from 2003 to 2005. Using this dataset, we have confirmed that endogenous prices are a serious problem not only because they yield biased and inconsistent estimates, but also because the OLS estimates resulting from average prices contradict some basic principles of economic theory. Using an instrumental variables estimator, by contrast, yields a well-behaved cinema demand in Spain that is decreasing in ticket prices.

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