Entry and Pricing on Broadway*

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Abstract

This paper investigates the pricing decisions of Broadway shows. We find evidence that incumbent Broadway shows lower prices several weeks prior to the opening of a new show. In addition, prices are lower when the threat of competition, due to more entrants, is larger. A decomposition suggests that prices are more important than quantities for changes in revenue prior to entry and that this pattern reverses after entry occurs.

Keywords: Entry accommodation; Broadway; event study; quantile regression.

JEL codes: L1

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1 Introduction

Economists have long been interested in understanding the incentives of incumbents to take preemptive actions under threat of entry. Several theories have been proposed to explain preemptive actions on the part of incumbents. For example, a potential entrant may be deterred from entering a market if the incumbent sets a price to signal that entry will not be profitable (Milgrom and Roberts, 1982). In addition, incumbents may increase market share or deter entry by relying on investment in new capacity (Dixit, 1979), learning-by-doing (Spence, 1981), contracts (Aghion and Bolton, 1987), and switching costs (Klemperer, 1987). Empirical evidence on the extent and determinants of preemptive behavior is limited. Most attention in the literature has been directed at the US domestic airline industry (see Morrison (2001), Goolsbee and Syverson (2008), and Gedge, Roberts, and Sweeting (2014)).

We examine the pricing decisions of Broadway theater productions, which in recent years have generated around $1 billion in annual revenue based on more than 10 million tickets sold (Broadway League, 2015). By studying Broadway we are able to exploit the fact that entry decisions are publicly announced and (almost) certain to identify periods in which entry is threatened. This allows us to overcome two key obstacles in quantifying the extent to which firms lower prices to accommodate entry. First, in other industries entry may be endogenous to periods in which prices are systematically higher or lower. Second, periods in which entry is threatened are usually unobserved. Our data allow us to control for what may be substantial differences in show quality, by focusing on weekly *within*-show variation in prices during and after periods in which entry is threatened. Furthermore, due to the geographic concentration of Broadway shows, we are able to analyze an industry in which all firms face the same external factors, eliminating any variation in prices due to location.

Our empirical analysis relies on newly collected data on weekly average ticket prices to examine incumbent price dynamics in the weeks prior to entry. A natural concern is the potential endogeneity of the entry events. We argue that this is not the case in our setting since shows announce their opening several months in advance. We find that incumbents lower prices up to two percent before the opening of a new show. In addition, incumbents

are responsive to the strength of competition: prices decrease more when the number of entrants is higher. We also show that the effects are heterogenous over the distribution of prices: if prices are correlated with quality, we find that low-quality shows are more affected by entry than the more expensive shows. Finally, we show that prices are more important than quantities for changes in revenue prior to entry.

2 Motivating Theory

A natural starting point for the empirical analysis is the two-period model of Milgrom and Roberts (1982). In the first period the potential entrant does not know the incumbent's marginal cost but observes the incumbent's price (or output). All participants know the cost of entry. If entry occurs in the second period all information is revealed and firms engage in static competition. In equilibrium the incumbent lowers its price to signal industry profits are low, but the entrant may not be deterred. Indeed, the logic of the Milgrom and Roberts (1982) model allows for the probability of entry to be no lower in the limit pricing equilibrium.

In our setting, entry is publicly announced and (almost) certain. However, there is still uncertainty regarding incumbent costs and the amount of residual demand a new entrant can capture. As a result, an incumbent may lower prices to signal low cost or diminish the portion of demand left to the entrant but not to fully deter entry. Therefore, this is not a case of limit pricing, but of entry accommodation.

3 Data

The website Play Bill Vault (2015) publishes weekly reports containing key information for all Broadway shows since 1985. In particular, in each week we observe the show and theater names, gross revenues, average ticket price, and seats sold. We convert all prices to constant 2015 dollars.

Table 1: Summary Statistics

	Mean (1)	Std. Dev. (2)
# of shows per week	18.90	4.91
average ticket	75.33	24.68
total seats	7,709	3,183
# of entrants	0.62	0.89

Table 1 shows summary statistics for our sample. The mean number of entrants reflects the fact that for weeks with entry there is more than one show opening and that there are sequences of weeks with no entry. For each show we also identify the opening week and construct an indicator for the week in which entry occurred. We then define the set of incumbents for each week in which there is entry as all shows that exist prior to entry.[1]

The goal of the empirical analysis is to quantify incumbents' response to future entry. To construct our dataset we let market j index the set of incumbents in the week of entry. We then extract a 10-week window around each entry event and re-center the data so that $\tau = 0$ is the week in which entry occurred. We drop all entrants associated with $\tau = 0$ so that only incumbents are left. This means that shows that are entrants in one week become incumbents in later weeks. Our results are not sensitive to choosing shorter or longer windows around each entry event.

4 Empirical Analysis

The empirical analysis quantifies incumbents' response to entry using an event study controlling for differences in incumbent quality, entry date, and seasonality. In particular, our baseline specification is:

$$\log y_{ijt\tau} = \gamma_{ij} + \sum_{\tau=-5}^{10} \beta_\tau \text{entry}_{j\tau} + f(\text{week}_t) + \varepsilon_{ijt\tau} \tag{1}$$

[1] See Online Appendix A.

where $y_{ij\tau}$ is usually average price of incumbent i in market j at time t observed τ weeks from the entry event. We also estimate specifications with tickets sold and revenue as the outcome variables. The fixed effects γ_{ij} capture differences in prices due to differences in the quality of incumbent i as well as differences across market j. Such differences would arise, for example, if the degree of competition, possibly due to a higher number of incumbents, varied across markets. The term $f(\text{week}_t)$ is a third-order polynomial function in the week of entry that controls for weekly variation in average prices over time. This variation could reflect seasonality in an incumbent's pricing policy that may be confounded with changes in prices as the prospect of new entrants approaches (Einav, 2007). The variables $\text{entry}_{j\tau}$ are time dummies surrounding the entry event, so that the associated coefficients β_τ measure the change in price in week $\tau \in [-5, 10]$ relative to the level six or more weeks prior to entry (the excluded group). Importantly, the results are qualitatively similar if we change the range over which β_τ is allowed to vary. To examine heterogeneity in the preemptive pricing response on the part of incumbents we also include a variable to capture the strength of competition.

Two key issues related to identifying preemptive pricing behavior are addressed by the specification in equation (1). First, the incumbent-market fixed effects (γ_{ij}) control for differences in the quality of incumbent i that vary across market j. Recall that a market is defined as the ten weeks before and the ten weeks after each entry event so that γ_{ij} can be interpreted as adjusting for the combined effect of incumbent i's quality and composition of shows in market j.

Second, entry is publicly announced several weeks prior to actual entry and so is known to incumbents, sometimes up to 9 months before the opening. This implies that prices are a function of the entry events and not the opposite.[2] This also allows us to interpret behavior in the weeks leading up to (known) entry at $\tau = 0$ as preemptive. Importantly, this removes the endogeneity concern that arises due to the fact that entry decisions may respond to the

[2]Evidence on the existence of a public date for the event of entry is found in numerous local newspapers and more recently in websites such as the Internet Broadway Database (http://www.ibdb.com/) and the New York Theatre Guide (http://www.newyorktheaterguide.com/whatson/opening.htm) which post the names and dates of new shows as early as six months in advance.

set of prices currently charged by incumbents. If entrants tend to enter when prices are high this will bias our estimates upward.

4.1 Results

Our results are presented in Table 2. Columns 1 through 4 show estimates for β_τ from specifications with different outcome variables. Standard errors are clustered at the show and entry date level to allow for serial correlation in incumbent i's prices within the same market j. Alternatively, standard errors computed based on clustering by incumbent tend to be smaller. In general, the coefficients with (log) average price as the outcome variable are negative several weeks prior to entry.

Column 1 presents the results for the trajectory of prices with no controls. In column 2, adding fixed effects for incumbent by entry date reduces the magnitude of the coefficient estimates but the effect between five weeks before and three weeks after entry remains statistically and economically significant. Weighting the regression by market share in column 3 does not alter the interpretation. Figure 1A plots the change in price based on the estimated coefficients.[3] The figure shows that price decreases by incumbents occur several periods prior to entry.

Column 4 of Table 2 adds a measure of the strength of competition from entrants (i.e., the number of entrants in market j) interacted with an indicator for the pre-entry period. The coefficient on this variable is negative and statistically significant, which suggests that more entrants leads incumbents to lower prices even further prior to entry. Note that the effect of the number of entrants is large since it is in addition to the level effect of preemptive entry. The effect is consistent with an interpretation in which more entrants increase the competition faced by incumbents as well as an interpretation in which more entrants provide more potential for novelty in a given period.

Motivated by the negative coefficient on the strength of competition variable, we re-estimate the specifications found in columns 1 and 2 using subsamples of the entry events in

[3]Note that since we use a log-linear specification the percentage change is equal to $100 \times \exp(\beta_\tau) - 100$.

Table 2: Effect on Incumbents Before and After Entry

	Dependent Variable (y_{ijt})**:**			
	price	price	price	price
	(1)	(2)	(3)	(4)
$\tau = -5$	-0.0138***	-0.0091***	-0.0091***	-0.0092***
	(0.0020)	(0.0012)	(0.0010)	(0.0012)
$\tau = -4$	-0.0180***	-0.0130***	-0.0121***	-0.0130***
	(0.0024)	(0.0013)	(0.0012)	(0.0013)
$\tau = -3$	-0.0171***	-0.0106***	-0.0101***	-0.0106***
	(0.0026)	(0.0014)	(0.0012)	(0.0014)
$\tau = -2$	-0.0217***	-0.0137***	-0.0131***	-0.0136***
	(0.0028)	(0.0015)	(0.0013)	(0.0015)
$\tau = -1$	-0.0271***	-0.0171***	-0.0160***	-0.0169***
	(0.0030)	(0.0015)	(0.0013)	(0.0015)
$\tau = 0$	-0.0145***	-0.0113***	-0.0114***	-0.0238***
	(0.0029)	(0.0015)	(0.0013)	(0.0025)
$\tau = 1$	-0.0162***	-0.0077***	-0.0081***	-0.0201***
	(0.0031)	(0.0016)	(0.0014)	(0.0026)
$\tau = 2$	-0.0180***	-0.0080***	-0.0085***	-0.0204***
	(0.0032)	(0.0016)	(0.0015)	(0.0026)
$\tau = 3$	-0.0220***	-0.0083***	-0.0088***	-0.0207***
	(0.0033)	(0.0017)	(0.0015)	(0.0026)
$\tau = 4$	-0.0206***	-0.0048**	-0.0068***	-0.0173***
	(0.0034)	(0.0017)	(0.0015)	(0.0026)
$\tau = 5$	-0.0181***	-0.0013	-0.0039*	-0.0138***
	(0.0034)	(0.0017)	(0.0015)	(0.0027)
$\tau = 6$	-0.0172***	0.0004	-0.0024	-0.0121***
	(0.0034)	(0.0017)	(0.0016)	(0.0027)
$\tau = 7$	-0.0129***	0.0048**	0.0009	-0.0077**
	(0.0034)	(0.0017)	(0.0016)	(0.0027)
$\tau = 8$	-0.0103**	0.0100***	0.0052**	-0.0025
	(0.0034)	(0.0018)	(0.0016)	(0.0027)
$\tau = 9$	-0.0065	0.0155***	0.0097***	0.0030
	(0.0035)	(0.0018)	(0.0016)	(0.0028)
$\tau = 10$	-0.0058	0.0175***	0.0110***	0.0049
	(0.0035)	(0.0019)	(0.0017)	(0.0028)
# entrants $\times$ $1\{\tau < 0\}$				-0.0086***
				(0.0014)
R^2	0.001	0.921	0.925	0.921
Incumbent fixed effects	no	yes	yes	yes
3rd-order poly. in week	no	yes	yes	yes
Weighted by market share	no	no	yes	no

Notes: The dependent variable is (log) average price in columns 1 through 4. The coefficients reported are on indicators for five weeks before and up to ten weeks after entry occurs, where weeks more than five weeks before are part of the excluded group. Standard errors are clustered at the show and entry date level. The number of observations in each column is 189,679.

which 1 show entered, 2 shows entered, and 3 or more shows entered. Figure 1B displays the coefficient estimates for each of the entry subsamples. These estimates do not include any of the controls. The estimates from specifications that include incumbent fixed effects and a third order polynomial in week are found in Figure 1C. Both specifications further support the notion that incumbents lower prices more in periods immediately before entry when the number of entrants is large.

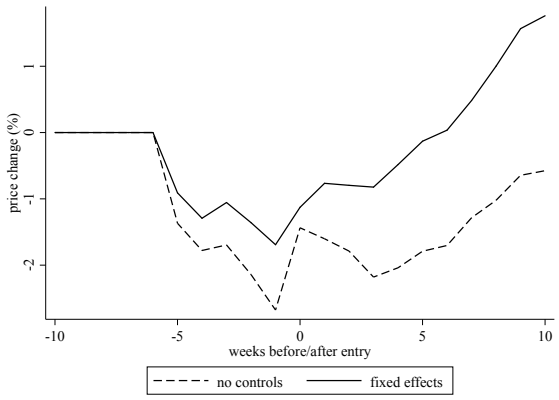
To examine how prices at different points in the distribution respond to the threat of entry, we consider the estimates from a quantile regression. Specifically, Figure 1D plots coefficients similar to those reported in Figure 1A, but where the effect of the threat of entry is different throughout the price distribution. Price declines prior to entry are largest at the 10th percentile relative to higher percentiles. This suggests that shows with lower prices–which may reflect an additional dimension of relative quality–are more threatened by entry and this is realized after entry occurs. We also consider the effects on seats sold by replacing the dependent variable in the main specification with the (log) seats sold. A decomposition exercise based on these results shows that the change in price accounts for 60 percent of the change in revenue before entry relative to 33 percent in the 7 weeks after entry.[4]

The pattern of price and quantity movements before and after entry reflects several features of Broadway. First, new shows have the competitive advantage of novelty relative to incumbents. Empirically we show that incumbents recognize this fact and reduce prices prior to entry. After entry occurs, consumers are drawn to novelty and the effect on quantity (relative to price) changes dominates.[5] Second, as Becker (1991) and Moretti (2011) suggest, the increasing role of quantity relative to price movements following entry is an indication of the role of externalities in demand as consumers learn about show quality. Following entry, the number of tickets sold by incumbents decreases and the number of tickets sold by new entrants increases. Additional results show that movements in incumbent market share are even more negative (i.e., up to 10 percent) for several weeks after entry.

[4]See Online Appendix B.

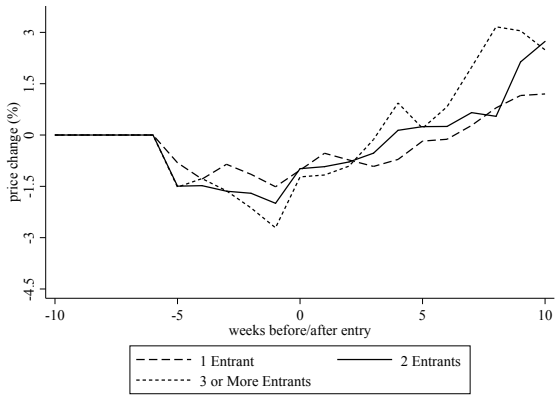
[5]Note that the increasing role of prices after $\tau = 5$ is associated with increases in prices.

Figure 1: Effect on Incumbent Prices Before and After Entry

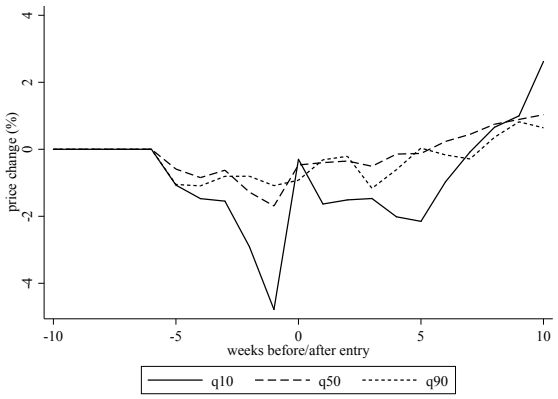


A. OLS Regression

B. Subsample Regression (no controls)



C. Subsample Regression (incl. controls)



D. Quantile Regression

Notes: Panel A shows estimated coefficients from column 1 (dash) and column 2 (solid) of Table 2. The coefficients for $\tau \in [-10, -6]$ are fixed at zero and coefficients for subsequent weeks are relative to this period. Panel B shows estimated coefficients for a subsample with 1 entrant (dash), 2 entrants (dots), and 3 or more entrants (solid), with no controls (analogous to column 1). Panel C shows estimated coefficients for a subsample with 1 entrant (dash), 2 entrants (dots), and 3 or more entrants (solid), with fixed effects and a third order polynomial in week (analogous to column 2). Panel D shows estimated coefficients from a quantile regression at different percentiles.

5 Conclusion

Do firms take accommodating actions (e.g., lowering price or increasing investment) when faced with the threat of new entrants? Despite substantial theoretical interest in this topic, there is limited empirical work. In this paper, we examine the quantitative importance of the threat of entry to the pricing decisions of incumbents on Broadway. We find evidence that incumbents lower prices prior to the entry of new shows. A simple decomposition of the change in revenue suggests that changes in prices are more important than changes in number of tickets sold prior to entry; this pattern reverses after entry occurs.

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Entry and Pricing on Broadway

Online Appendix

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A. Data

We used the XML package in R to retrieve the data (Lang, 2013). Specifically, for each entry event we define the associated market as the set of incumbents at the date of entry and their corresponding observations in a 10-week window around that entry event. The entrant is removed from this set of observations so that we only measure the pricing decisions of incumbents. This setting allows us to exploit the variation in the timing of entry events relative to each of the particular set of competitors in the week in which entry occurs.

The average number of shows and the average ticket price across all market-week observations is 18.9 and $75.33, respectively. The average number of tickets sold per week was 7,709. Figure A.1A shows the average ticket price and Figure A.1B shows the number of total tickets sold in each week from June 30, 1985. These figures exhibit seasonality which we control for in our regressions (discussed in Section 4 in the main text).

B. Decomposition of the Effect on Prices

Column 2 of Table B.1 replaces the dependent variable in the main estimating equation with (log) seats sold; column 3 shows results with (log) revenue as the dependent variable, and column 1 repeats our main specification from Table 1 in the main text. To see the relative importance of price versus quantity changes before and after entry, contrast the estimated change in revenue three weeks before ($\beta_{\tau=-3} = -0.0177$) and after ($\beta_{\tau=3} = -0.0250$) entry.

In this case, the change in price accounts for 60 percent of the change in revenue before entry relative to 33 percent after entry. This calculation is based on a decomposition in column 4 of Table B.1, which shows the absolute value of column 1 divided by the sum of

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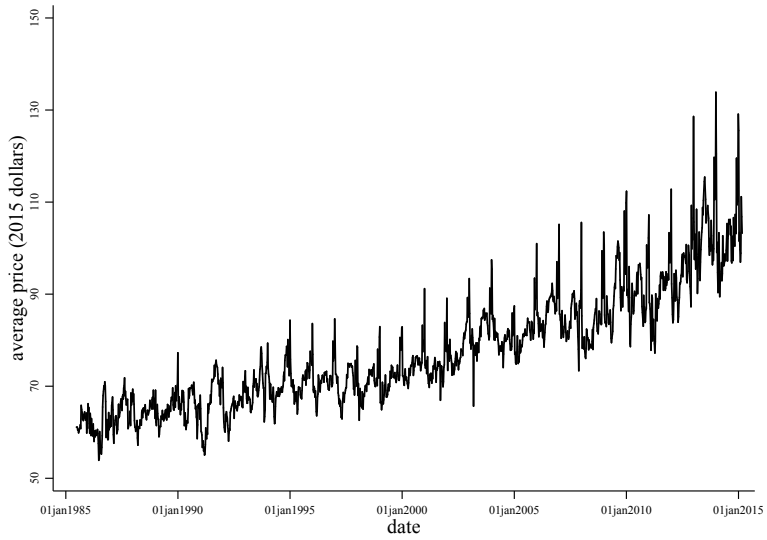
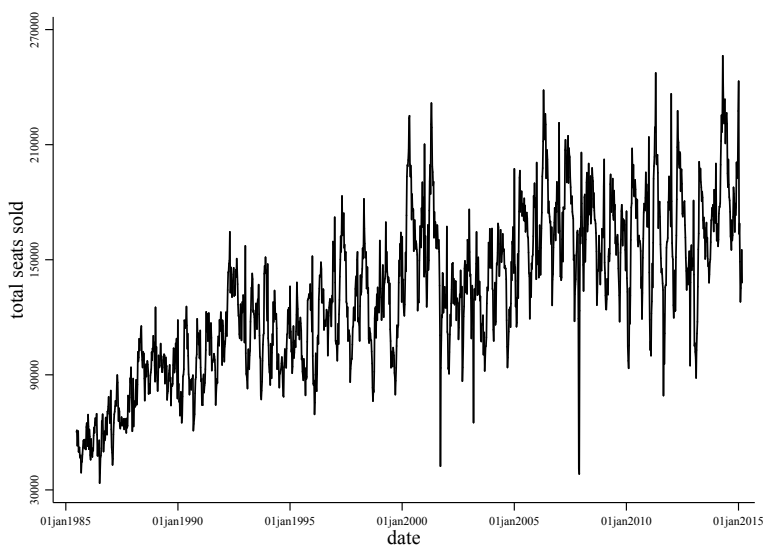
Figure A.1: Weekly Average Ticket Price and Tickets Sold, 1985-2015



A. average ticket price



B. total tickets sold

Notes: Panel A shows average ticket price and Panel B shows total number of tickets sold each week from 1985 to 2015.

Table B.1: Decomposition of Effect on Incumbents Before and After Entry

	Dependent Variable (y_{ijt})**:**			
	price	tickets	revenue	(1) ÷ (3)
	(1)	(2)	(3)	(4)
$\tau = -5$	-0.0091***	-0.0069**	-0.0161***	56.5
	(0.0012)	(0.0024)	(0.0027)	
$\tau = -4$	-0.0130***	-0.0128***	-0.0258***	50.4
	(0.0013)	(0.0026)	(0.0030)	
$\tau = -3$	-0.0106***	-0.0070**	-0.0177***	59.9
	(0.0014)	(0.0025)	(0.0031)	
$\tau = -2$	-0.0137***	-0.0116***	-0.0253***	54.2
	(0.0015)	(0.0027)	(0.0033)	
$\tau = -1$	-0.0171***	-0.0150***	-0.0320***	53.4
	(0.0015)	(0.0028)	(0.0034)	
$\tau = 0$	-0.0113***	0.0050*	-0.0063*	69.3
	(0.0015)	(0.0024)	(0.0031)	
$\tau = 1$	-0.0077***	-0.0103***	-0.0179***	43.0
	(0.0016)	(0.0028)	(0.0035)	
$\tau = 2$	-0.0080***	-0.0132***	-0.0212***	37.7
	(0.0016)	(0.0028)	(0.0035)	
$\tau = 3$	-0.0083***	-0.0168***	-0.0250***	33.2
	(0.0017)	(0.0028)	(0.0035)	
$\tau = 4$	-0.0048**	-0.0162***	-0.0210***	22.9
	(0.0017)	(0.0028)	(0.0035)	
$\tau = 5$	-0.0013	-0.0105***	-0.0118***	11.0
	(0.0017)	(0.0027)	(0.0035)	
$\tau = 6$	0.0004	-0.0135***	-0.0131***	22.9
	(0.0017)	(0.0028)	(0.0036)	
$\tau = 7$	0.0048**	-0.0102***	-0.0054	32.0
	(0.0017)	(0.0027)	(0.0036)	
$\tau = 8$	0.0100***	-0.0064*	0.0036	61.0
	(0.0018)	(0.0028)	(0.0037)	
$\tau = 9$	0.0155***	0.0007	0.0162***	95.7
	(0.0018)	(0.0027)	(0.0037)	
$\tau = 10$	0.0175***	0.0070*	0.0245***	71.4
	(0.0019)	(0.0028)	(0.0037)	
R^2	0.921	0.867	0.918	

Notes: The dependent variable is (log) average price in column 1, (log) seats sold in column 2, and (log) revenue in column 3. Column 4 shows the absolute value of column 1 divided by the sum of the absolute values of columns 1 and 2 (multiplied by 100), which gives the relative movement in the price and quantity coefficients that is due to movements in the price coefficient. In columns 1 through 3, the coefficients reported are on indicators for five weeks before and up to ten weeks after entry occurs, where weeks more than five weeks before are part of the exlcuded group. All specifications include incumbent fixed effects. Standard errors are clustered at the show and entry date level. The number of observations in each column is 189,679.

the absolute values of columns 1 and 2 (multiplied by 100), which gives the relative movement in the price and quantity coefficients that is due to movements in the price coefficient. From column 4 of Table B.1, this result is consistent across the different weeks before and after entry; in general, price changes are larger than quantity changes in periods before entry and this pattern reverses after entry.

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