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Pricing and Multi-Market Contact in the Cable TV Industry

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Abstract:
This paper links empirical literature on the use of price as an entry deterring mechanism with literature on the effect of multi-market contact on competition. The analysis uses a dataset of cable TV system prices to provide evidence that incumbent cable TV firms use price to deter entry by telecom overbuilders as well as cities with municipal utilities. There is also some evidence that multi-market contact with telecom overbuilders results in lower prices. However, there is no evidence that incumbents use price to deter cable overbuilders. In addition to linking entry deterrence with multi-market contact, this study has two other unique features. First, it establishes entry deterrence using two techniques, one of which relies on theory by Ellison and Ellison (2008) on non-monotonic price decreases in response to entry probability. Second, it uses detailed price and channel data at the service tier level.

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1. Introduction

The goal of this paper is to link empirical literature on the use of price as an entry deterring mechanism with literature on the effect of multi-market contact on competition. The paper accomplishes this within the context of the US cable TV industry. The cable TV industry is an important industry to understand from a public policy point of view; it is a $100+B per year industry in the US and the average adult spends about four hours per day watching TV. From a methodological point of view, there are many attractive features of the industry that allow for careful identification of incumbents and entrants. In particular, this paper tests whether or not incumbent monopolists use price as a way to deter potential entry and whether multi-market contact between the incumbent and potential entrant modifies the extent to which the incumbent will use price to deter entry. The analyses find no evidence that incumbent cable TV firms use price to deter entry by cable overbuilders, but there is evidence that incumbents use price to deter entry by telecom overbuilders and municipal utilities. Identification in the case of municipal utilities comes from cross-sectional variation in the presence of municipal utilities in some cities and temporal variation from states that pass laws restricting municipal utility entry. Identification of entry deterrence in the case of telecom overbuilders comes from cross sectional and temporal variation in the distance to potential entrants. The identification is aided by additional temporal variation from states that switch to state-wide franchises as well as from theory and tests developed by Ellison and Ellison (2007) which suggests that an incumbent's entry deterring response will be a non-monotonic function of the probability of entry. In addition, there is evidence that multi-market contact plays a strong moderating role when the incumbent faces potential telecom entry. Firms not in multi-market contact with potential telecom entrants appear less likely to use entry deterrence, whereas firms in multi-market contact with potential telecom entrants appear to price lower.

Ellison and Ellison (2007) show that under certain conditions, investment A(z) will be a monotonic function of a characteristic z of the market when entry deterrence motivations are absent. They suggest that characteristic z might be the number of potential customers in the market. The conditions under which monotonicity holds are that profits for the entrant are increasing in z, and the direct and competition effects are the same direction (either both positive or both negative). The direct effect of z on A(z) will be positive if an increase in z raises the marginal benefit of the investment more than the marginal cost; the competition effect of z on A(z) is positive if the marginal benefit of z is larger when firm 1 is a duopolist than when a monopolist. The result lends itself to a simple test: if A(z) is not a monotonic function of z , then entry deterrence motivations are present. Ellison and Ellison (2007) provide details of the model, its proofs, a simulation and an application to the pharmaceutical industry. In their application to the pharmaceutical industry, Ellison and Ellison consider a number of mechanisms through which the incumbent might deter entry including price and advertising. The link between price and investment has been made elsewhere in the literature. Bagwell (1993) develops a model of entry deterrence in which the incumbent first chooses to invest *I* in a technology of cost *c(I)*, and then uses price *P* to signal the level of investment to a potential entrant. A low price signals that the incumbent has invested a large amount in lowering cost. Similarly, Milgrom and Roberts (1982a) show low prices can deter entry when information is asymmetric.

The only other paper of which we are aware that uses the theory and methodology outlined by Ellison and Ellison (2007) is by Dafny (2005) who shows that hospitals invest in surgical procedure volume to move down a learning curve and thereby deter potential entrants. Dafny adapts the Ellison and Ellison model to a situation where investment by the incumbent is observed, as are the number of potential entrants, but not the underlying characteristic (z) that determines the attractiveness of the market. Additional conditions regarding complementarities of inputs into quality are required. Dafny shows that as the number of potential entrants increase, the incumbent hospital responds by increasing surgical procedure volume in a non-monotonic fashion; the incumbent increases volume more when there are two potential entrants compared to when there are 4+ potential entrants. Again, the intuition is straightforward: as the probability of entry becomes very high, there is less incentive to deter the entrant.

Several other papers investigate incumbent use of price to deter entry, and find mixed results. Goolsbee & Syverson (2008) show that incumbent airlines drop price in response to increases in threat of entry from Southwest. Simon (2005) focuses on post entry actions of the incumbent and finds that newer incumbents in the magazine industry cut prices in response to entry more aggressively than older incumbents. In a study closely related to this one, Savage and Wirth (2005) find that potential entrants have no effect on incumbent cable TV firm prices, but do have a positive effect on the number of channels offered by the incumbent. This study differs from Savage and Wirth in several ways. Savage and Wirth use a probit model to predict entry whereas this study uses the distance between an entrant and incumbent to predict entry. In addition, this study does not use number of channels, but instead uses a hedonic approach to decompose price across all available channels, as will be described below. This study also focuses on the use of price to deter entry by cities with municipal electric utilities; it builds off of work by Seamans (2008) showing that incumbent cable firms use technology upgrades to deter entry by cities with municipal utilities. It is possible that incumbent cable TV firms also use price as an entry deterring mechanism when confronted with potential city entry. Finally, this study uses a panel dataset to focus on the effect of multi-market contact on pricing decisions over time. Unlike irreversible sunk cost investments, prices can be adjusted over time as conditions change. Such inter-temporal considerations are central to any study that focuses on price (Williamson, 1977).

Theory on pre-entry effects of multi-market contact in the economics literature dates to work by Milgrom and Roberts (1982b) who suggest that the returns to an incumbent from dropping price to deter an entrant will be increasing in the number of markets that the incumbent operates. Their model relies on information asymmetry between the two firms. When the incumbent firm drops price low enough, the entrant infers that the incumbent is a low cost provider, and is deterred from entering (if it infers the cost is low enough to make entry unprofitable). If the incumbent operates in multiple markets, and encounters the same potential entrant in those markets, then there is additional incentive for the incumbent to invest in establishing a reputation as a low cost provider. While theory suggests that pre-entry multi-market contact leads to price decreases, theory also suggests that post-entry multi-market contact leads to price increases. Bernheim and Whinston (1990) develop a model of multi-market contact that suggests when more than one firm is in the market and the firms are different from each other there are increasing incentives to engage in mutual cooperation when interacting across multiple markets. Hughes and Oughton (1993) suggest that multi-market contact may increase incentives to engage in collusive behavior; a strategy that has become known as "mutual forbearance" (Bernheim and Whinston, 1990).

Empirical work on multi-market contact primarily focuses on post-entry interactions. Results tend to support the prediction that multi-market contact leads to higher prices. In a cross industry study, Hughes and Oughton (1993) find that price-cost margins are higher in industries with greater multi-market contact. Heggestad and Rhoades (1978) find that multi-market contact in the banking industry leads to less rivalry. Baum and Korn (1999) find that rates of entry and exit into airline routes vary in a curvilinear way with the amount of multi-market contact between pairs of competitors. This paper adds to empirical literature on multi-market contact by considering pre-entry actions of the incumbent and linking entry deterrence motives with multi-market contact in the context of the cable TV industry. Incumbent cable TV firms appear not to use price to deter entry by cable overbuilder entrants, but do appear to use price to deter entry by telecom overbuilder entrants. The differing response may be due to information asymmetries between incumbent cable firms and telecom entrants. In addition, results show that firms in multi-market contact with potential telecom entrants have lower prices than those firms not in multi-market contact with potential entrants.

The next section of the paper provides background on the cable TV industry. Section 3 then describes the data and methods used. Section 4 discusses results and Section 5 concludes.

2. Cable TV Industry

The contractual relationship between the city and the cable firm is governed by a franchise agreement which typically runs 10-15 years in length. Due to various changes in regulation, by 2003 franchise renewals are more or less automatic and are non-exclusive, meaning that a city can enter as a competitor or invite other firms to enter as competitors, and most cable rates are unregulated (Crandall, Sidak &Singer, 2006). Even though franchises are non-exclusive, 99% of cities have only one incumbent cable system. Cable systems face competition in the video market in the form of digitally broadcast satellite (DBS) providers, and competition in the broadband market in the form of digital subscriber line service (DSL) offered by telecom companies. DBS providers were not a serious competitor until after the 1999 Satellite Home Viewer Improvement Act (SHVIA) that allowed DBS providers to carry local signals; but by 2003 DBS coverage was more or less ubiquitous (Crawford, 2006).

While most cities have one incumbent cable TV provider, in the late 1990s, several private companies were formed with the explicit purpose of entering and competing with incumbent cable TV firms. Companies such as RCN and Knology built their own cable networks; companies such as Qwest and Verizon created subsidiaries to use existing telephone infrastructure to offer video. Collectively, these private entrants are called “overbuilders”. Typically, overbuilders will focus on a specific geographic area. For example, in its 2005 Annual Report, RCN notes that its strategy is to selectively expand its footprint: “RCN will continue to seek opportunities to increase its network footprint within and adjacent to its existing market clusters."[1] Building off of the existing footprint allows the private overbuilder to take advantage of economies of scale in customer service and maintenance and repair. Thus, in principle one can measure the threat of entry from an overbuilder by measuring the distance in miles from an incumbent system and the edge of the closest cluster of overbuilders.

An explicit intention of the Telecommunications Act of 1996 was to encourage use of electric utility infrastructure to increase competition in telecommunications and video programming services. Electric utilities, including city-owned municipal electric utilities, own infrastructure that can be used to build out cable TV and other telecommunications services. There are several reasons city governments in particular are able to enter at low cost. First, cities with municipal utilities may be able to take advantage of economies of scope. Service trucks and customer service representatives can be used to serve the same customers; existing fiber optic networks can be used for the cable TV network. Many local governments operate public telecommunications infrastructure (often called i-Nets) that connects city departments; Gillet, Lehr and Osorio (2006) have suggested that existence of these i-Nets leads to economies of scope and learning effects that drop the cost to the city of installing and operating its own cable TV system. Local governments may be able to use tax-free financing in the form of municipal bonds to build out cable TV networks. As a result of the foregoing, following full implementation of TA96, a number of cities have entered and started to provide cable TV service; by 2002, close to 100 cities provided cable TV service (Gillett, Lehr, Osorio, 2004). For example, Alameda Power & Telecom, a municipal electric utility in Alameda, California, used its existing utility infrastructure to build a cable system in 2001.

[1] RCN SEC Form 10-K, page six. Available for download here: http://investor.rcn.com/downloads/4-10-06_10KA.pdf

In many cases cities need voter or state approval before offering their own telecommunications system and the presence of laws regarding these legal requirements add to the fixed cost of setting up a system. A number of states have proposed and passed legislation that limits a city's ability to provide its own cable TV service. Some states prohibit the city from using the municipal utility to cross subsidize new businesses such as telecom or cable, whereas other states allow cities to offer telecom or cable services after receiving voter approval. [2] After such a law is passed, cities with municipal utilities may no longer have a low cost advantage; while in some cases they may still be able to use the municipal utility infrastructure, they may need to incur additional costs to satisfy state legislation. In addition, a number of states have switched from a franchising system that is performed at the city level to a state-wide franchising system.[3] This means that if a new entrant wants to offer video services to any city in the state, the entrant need only negotiate once with the state instead of with each individual city.

3. Data and Methodology

3.1. Data and Variable Construction

Data comes from Warren Communications Cable TV *Factbook* for three different time periods: October 2003, January 2006 and August 2008. The *Factbook* data is the main source of cable TV system level characteristics used in most empirical studies of the industry.[4] All cable variables are measured at the system level. 2003 is late enough after the passage of SHVIA that DBS coverage is more or less ubiquitous, which lessens the extent to which any effect we find is

[2] States that passed no cross subsidy legislation include Florida, Tennessee, Utah and Virginia prior to 2003, Iowa, South Carolina in 2003 and Wisconsin in 2005. States that had other forms of restrictions include Alabama, Missouri, Nebraska, Nevada, Texas prior to 2003, Washington in 2003 and Pennsylvania in 2005.
[3] States that enacted state franchises for video programming include Alaska, Connecticut, Hawaii, Rhode Island and Vermont prior to 2003, Texas in 2005, California, Indiana, Kansas, and Michigan in 2007.
[4] For recent examples, see Goolsbee and Petrin (2004) and Della Vigna and Kaplan (2007).

driven by unobserved heterogeneity in the presence of DBS offerings. The empirical analyses include two steps. The first step involves using information on price and channel at the service level to estimate a hedonic price for each system-service level observation. One of the unique features of this study is the use of detailed information on price and channels for each level of service. 19 service tiers are included as fixed effects in most regressions. There were an additional 14 service tiers that were used infrequently across the three years of data and dropped; dropping the extra service tiers resulted in reducing the total number of observations by less than 1%. It is important to note that other studies which have looked at cable TV system pricing have focused on only one tier of pricing, typically the basic service tier. The problem with using the pricing of only one tier of service is that channel lineups for a tier may be arranged differently across systems. For example, the *Cartoon Network* is marketed in different tiers in different cities. It appears along with 32 other channels in the basic tier in Stockton, CA, along with 43 other channels in the expanded basic tier in Alameda, CA, and along with 67 other channels in the digital basic tier in Bakersfield, CA. The methodology used in this paper explicitly captures the differences across systems by using service tier and channel lineups. For 2003, there were over 600 channels, for 2006, there were over 800 channels and for 2008 there were over 1000 channels. In addition, many of the channel names change from year to year. This poses an empirical challenge. One approach would be to match channels across years as best as possible, but the problem with this approach is that, incorrect matches aside, there would be a number of channels not used, especially those channels from later time periods. The approach taken here uses all channel and price information to estimate a hedonic price regression separately for each year, then uses the estimated coefficients from the price regression to predict price for each system – service level observation for each year. That is, the following regression is estimated:

(1) $\ln(monthly\_fee+1)_i = \alpha_0 + \Sigma_{j=1\text{-}19}\, \alpha_j servicelevel_j + \Sigma_{k=1\text{-}K}\, \alpha_k channel_k + \varepsilon_i$

Separate regressions are run for each year, so K = 661 in 2003, K = 873 in 2006 and K = 1078 in 2008. The estimated coefficients (α) are then used to predict ln(*monthly_fee+1*), which for simplicity we call *price* in regression equations below.

The most important independent variables used are indicators for potential entrants. *Municipal utility* indicates if a system is in a city that has a municipal utility provider. Cities with municipal utilities are able to use the municipal utility infrastructure to build out a cable system that competes with the incumbent. Data on municipal utilities was collected from the American Public Power Association. Counts of the number of overbuilders within a 100 mile radius are used to measure threat of private entry. These variables are constructed by setting a radius of 100 miles from the center of the incumbent's county and counting the number of overbuilders in counties that fall within that radius. Cable and telecom overbuilders are identified from owner information provided in the *Factbook*. The simplest measure is just a dummy for whether the count is greater than zero, but the count variables are also broken into five bins for 0, 1, 2, 3, 4+ overbuilders within 100 miles.[5] Summary statistics of the overbuilder bins, by number and type of overbuilder, are provided in Table 1, as is information on *municipal electric utility*. A distribution of the number of overbuilders within 100 miles, by type, is presented in Figure 1. While there is a long tail to the distribution, dropping the outliers or changing the bin size does not qualitatively alter the results.

[5] In other words, the dummy for when the count within 100 miles is greater than zero is just (1-bin for zero overbuilders in 100 miles).

The system ownership information is also used to create two additional control variables. The *log of number of systems owned by the firm* is included to control for firm size (as distinct from system size). Larger firms may have access to more resources such as bank loans or public market financing that enable them to more easily invest in entry deterring mechanisms. Regional ownership may also be important. *Share of systems* owned by the firm within each Designated Market Area (DMA) are calculated. The DMA assigns each city in the US to an area that is believed to receive the same media offerings. In most cases there is only one cable system per city, so cable systems do not compete with each other for residential customers. However, a portion of cable system revenue is in the form of advertising revenue. For example, in 2006, $1.5B of Comcast's $24.1B in revenue came from advertising. If a cable firm controls many systems in a DMA it may be able to exercise market power over local and regional businesses that want to advertise on a cable network. DMA level share is included to capture any such effects. *Homes passed* is a count of the number of potential hookups that the incumbent cable system passes. *Factbook* also contains information on the *miles of cable* installed in the system, which is included to measure system size. The number of *offair* channels (at the system level) is included to control for the number of local stations that a system is required to carry, which may reduce the number of other satellite channels the system is able to carry.

A *duopoly* dummy indicates if the system competes directly with another system in the same city. A dummy *private overbuilder* indicates if the system is owned by either a telecom or cable overbuilder. These variables, together with ownership information, were used to create multi-market contact variables. A firm which owns a system that is in a duopoly with a private overbuilder is coded as having multi-*market contact*. Separate variables are created for *multi-market (cable)* and *multi-market (telecom)* depending on whether the incumbent has interaction with one or the other type of potential entrant.[6] By 2001, the start of the data, digital broadcast satellite (DBS) availability was more or less ubiquitous. Other researchers have accounted for competition from DBS indirectly using demographic control variables.[7] Using a similar approach, DBS is accounted for using various demographic controls at the county level. The controls used are median *household income*, percent of population living in a *rural* area, and *population per square mile*.[8] The demographic data are from the *City and County Databook*.

3.2. Methodology

OLS models are used for all regressions. The main empirical specification for testing the effect of municipal electric utility is:

(2) $price_{it} = \beta_0 + \beta_m municpalutility_i + \boldsymbol{\beta_x X_{it}} + \varepsilon_{it}$

X includes all the cable system or cable firm characteristics as well as demographic control variables and fixed effects. Note that the municipal utility variable only varies in the cross section. Temporal variation comes from the passage of state laws restricting the city's ability to

[6] Not surprisingly, whether a firm is considered a multi-market contact firm or not is correlated with its size; correlations between *log number of systems* and with *multi-market contact (cable)* is 0.55, and with *multi-market contact (telco)* is 0.37.

[7] For example, Savage and Wirth (2005) account for DBS using the percentage of the population living in a rural area, the percentage of households living in multiple dwelling units, and the cable system operator's share of national systems.

[8] Other variables were considered such as population, number of households, and percentage of households living in multiple dwelling units but these variables were found to be highly correlated with *income*, *rural* and *population per square mile*. The *rural* variable is important to include as prior studies have demonstrated that cable service is highly inelastic in rural areas (Mayo and Otsuka, 1991).

cross subsidize a cable system with revenues from the utility. The main empirical specifications for testing the effects of private overbuilders are:

(3a) $price_{it} = \beta_0 + \beta_t Nonzero\ telecom\ overbuilders\ within\ 100miles_{it} + \boldsymbol{\beta_x X_{it}} + \varepsilon_{it}$

(4a) $price_{it} = \beta_0 + \beta_c Nonzero\ cable\ overbuilders\ within\ 100miles_{it} + \boldsymbol{\beta_x X_{it}} + \varepsilon_{it}$

Temporal variations in the use of state franchises for video programming are used to aid identification. Additional regressions use different bins in an attempt to use non-monotonicities in the incumbent's response to potential entry to identify entry deterrence:

(3b) $price_{it} = \beta_0 + \Sigma_{i=1\text{-}4}\ \beta_i I(number\ telecom\ overbuilders\ within\ 100\ miles{=}i) + \boldsymbol{\beta_x X_{it}} + \varepsilon_{it}$

(4b) $price_{it} = \beta_0 + \Sigma_{i=1\text{-}4}\ \beta_i I(number\ cable\ overbuilders\ within\ 100\ miles{=}i) + \boldsymbol{\beta_x X_{it}} + \varepsilon_{it}$

The bin for 0 overbuilders within 100 miles has been omitted. The approach in (3b) and (4b) is the approach followed by Dafny (2005). Under this approach, a significant coefficient on β_i and $\beta_i < \beta_{>i}$ would indicate non-monotonicity in the pricing decision of the incumbent. For example, if β_1 was negative and significant, and β_4 was zero or positive, there would be evidence that the incumbent engages in non-monotonic pricing by dropping price more when the probability of entry is in an intermediate range than when price is highly likely (which we assume is the case when there are many overbuilders nearby). Dafny (2005) explicitly compares β_1 to β_4, but in principle β_2 could be used instead of β_1 as will be done in some specifications below.

Effects of multi-market contact are investigated for those cases where the potential entrant is a telecom or cable overbuilder; a city with a municipal utility poses threat of entry in only a single market so is not considered in a multi-market context. In order to investigate the effect of multi-market contact, the following specifications are used:

(5a) $price_{it} = \beta_0 + \Sigma_{i=1-4}\, \beta_i I(\textit{number telecom overbuilders within 100 miles}=i) + \Sigma_{i=1-4}\, \beta_{i\_mmc} I(\textit{number telecom overbuilders within 100 miles}=i)*\textit{MMC measure for telecom}_{it} + \boldsymbol{\beta_x X_{it}} + \varepsilon_{it}$

(5b) $price_{it} = \beta_0 + \Sigma_{i=1-4}\, \beta_i I(\textit{number cable overbuilders within 100 miles}=i) + \Sigma_{i=1-4}\, \beta_{i\_mmc} I(\textit{number cable overbuilders within 100 miles}=i)*\textit{MMC measure for cable}_{it} + \boldsymbol{\beta_x X_{it}} + \varepsilon_{it}$

Where the *MMC measure* depends on whether the type of overbuilder is telecom or cable, and all other variables are as above. The coefficients between the interaction term and its associated bin are compared. $\beta_{i\_mmc} < \beta_i$ is taken to be evidence that multi-market contact raises incentives for firms to price lower.

4. Results

The results for all specifications are presented in Tables 2 – 5c. In the interest of clarity of presentation, coefficients on all but the most important variables have been suppressed, but are available from the author upon request.

Table 2 presents results from specification (2); the independent variable of interest is *municipal utility*. Column 1 includes only year and service level fixed effects; column 2 adds in DMA fixed effects; column 3 adds in system characteristics and county demographics. In most cases the market will be defined at the designated market area (DMA). The municipal utility variable does not vary with time, so a city fixed effects specification would wipe out any municipal utility effect. The DMA assignment is at a high enough level that the city level and county level variables will not be washed out, but low enough to still control for local demographic and market characteristics not already included in the specifications. There are 210 DMAs in the US. The negative coefficient on *municipal utility* in column 3, which is statistically significant at the 1% level, indicates that the presence of a municipal utility is correlated with a lower price. In order to determine the direction of causality, column 4 uses temporal variation from state laws that prohibit the city's ability to cross subsidize cable service with revenues from the municipal utility. The passage of these laws makes it more costly and hence less likely that the city will enter. Hence, after passage of a law, we expect the incumbent system to be less likely to lower price in an attempt to deter city entry. The coefficient of interest in column 4 is that on the interaction between *municipal utility* and *no cross subsidy*. This variable is positive, as predicted, but not significant at standard levels (p-value = 0.11). Taken as a whole, the evidence presented in Table 2 suggests that incumbent firms use price to deter municipal utility entry.

Table 3a presents results from specification (3a); the independent variable of interest is *potential telecom overbuilders>0*. Like Table 2, Table 3a adds in more controls in each column. The negative coefficient in column 3 suggests that incumbent firms price lower when the threat of telecom entry rises; however, this coefficient is not statistically significant. The goal of Table 3a is to use temporal variation from state laws to help identify whether incumbent firms use low prices to deter telecom overbuilder entry. To this end, column 4 uses temporal variation from the passage of state video programming franchise laws. The passage of these laws makes it less costly and hence more likely that telecom overbuilders will enter. Hence, after passage of a law, we expect the incumbent system to be more likely to lower price in an attempt to deter city entry. The coefficient on the interaction term in column 4 is negative and statistically significant at the 1% level, as predicted. Table 3b, representing the results of specification (3b) uses a different approach. Here we focus on how the incumbent firm reacts to increases in the threat of telecom overbuilder entry. Per Ellison and Ellison (2007), non-monotonic decreases in price to increases in threat of entry are taken as indications of entry deterrence. Following the approach in Dafny (2005), this is accomplished by performing tests of equality between the coefficients on mutually exclusive bins representing probability of entry. Columns 1-3 in Table 3b successively add in more controls. The coefficients of interest are on the bins for 1, 2, 3 and 4+ telecom overbuilders within a 100 mile radius (the bin for 0 has been omitted). None of the coefficients are statistically significant, but it does appear that the coefficient on the bin 2 is less than the coefficient on bin 4+. Tests for coefficient equality suggest that we cannot reject equality at less than the 24% confidence level in any of the regressions. In other words, there is scant evidence that the incumbent firm engages in non-monotonic price decreases to deter telecom overbuilder entry.

Tables 4a and 4b repeat the analyses for the case of potential cable overbuilder entry. However, there is little evidence that incumbent firms use price to deter cable overbuilder entry. Changes to the state franchise law appear to raise prices when the potential entrant is a cable overbuilder, and there is no evidence of non-monotonic price decreases. The former result would benefit from additional investigation in follow up work. One possible explanation for the price increase following passage of the state video franchise may entail incumbent cable firms and overbuilder cable firms working together to deter entry by telecom firms. In order to better tease out this possibility, it will be necessary to model how and where state franchises are passed.

Tables 5a-5c present findings on the effect of multi-market contact. Column 1 of Table 5a shows that incumbent firms are more likely to lower price when they are in multi-market contact with potential telecom overbuilder entrants; the coefficient on the interaction term is negative and statistically significant at the 1% level. In contrast, column 2 of the same table shows that incumbent firms are statistically no more likely to lower price when in multi-market contact with potential cable overbuilder entrants. Table 5b then investigates whether this basic relationship varies as the probability of entry increases by focusing on the coefficients on different bins. For ease of exposition, tests of coefficient equality are presented in a separate Table 5c. The results do not suggest any non-monotonic response to potential entry by firms in multi-market contact, but do verify the basic relationship uncovered in Table 5a: incumbent firms are more likely to price low to deter entry when the potential entrant is a telecom firm in multi-market contact with the incumbent.

5. Conclusion

The results of the analyses show evidence that incumbent firms use price to deter municipal electric utilities and potential telecom overbuilder entrants, but not potential cable overbuilder entrants. Evidence of the use of price to deter entry primarily comes from temporal variation in state laws and less so from non-monotonic decreases in price in response to increased threat of entry. Theory developed by Milgrom and Roberts (1982a) should help provide justification for the differential response to cities with municipal electric utilities and telecom overbuilders on the one hand and cable overbuilders on the other. In some cases, the monopolist incumbent may want to charge a price less than the monopoly price to signal low cost to potential entrants. Of course, rational entrants possessing complete information will not be affected by such pricing. However, if cost information is private, then the low price may signal some information to the potential entrant and be a useful deterrent. To the extent that there exist informational asymmetries in the video programming market, it is more likely to exist between the incumbent cable TV firm and potential telecom overbuilders or municipal electric utilities than between incumbents and potential cable overbuilders. Not only do incumbents and cable overbuilders use much the same technology, but they have been interacting with each other for close to a decade. On the other hand, telecom entrants use different technology (for example, Verizon FiOS uses fiber-to-the-home) and only started to seriously enter the video programming market in the mid 2000s. RCN, the primary cable overbuilder, was founded in 1997 whereas Verizon FiOS did not have any communities online until 2005.[9]

While here the focus is on informational asymmetries, the idea that asymmetries of any sort might affect outcomes is well established in the literature. Collusion is illegal, but tacit collusion may be attainable if two firms in an industry are symmetric along all dimensions (Schelling, 1960). As the firms become more asymmetric along any one dimension, the coordination required to sustain a collusive outcome becomes more difficult (Scherer, 1980). In the context of the video programming market, post entry coordination may be difficult for incumbent cable TV firms and telecom overbuilders because of asymmetries in technology. As a result, post-entry

[9] While Verizon FiOS first went live in September 2005, the company had been obtaining video programming franchises from cities and building infrastructure before then: http://telephonyonline.com/technology/news/verizon_fios_keller_020305/ .

profits may be lower and, hence, we would expect the incumbent cable TV firm to use stronger ex-ante entry deterring strategies. Similarly, there may be differences in objective functions of cities with municipal electric utilities and incumbent cable firms. The city poses a threat in that, if it enters, it may pursue different objectives (Hauge, Jamison, Gentry, 2008). Emmons and Prager (1997) show that public-private cable TV duopolies have prices 30-40% lower than private-private cable TV duopolies. In addition, Bernheim and Whinston (1990) suggest that single market firms, which would be the case for the city should it enter, are likely to decrease the ability of an incumbent firm to rely on multi-market contact.

The results also show that incumbent firms that are in multi-market contact with potential telecom entrants are more likely to have lower prices than firms not in multi-market contact with potential entrants. There is much empirical evidence of high prices in the presence of multi-market contact between existing firms (Hughes and Oughton, 1993; Baum and Korn, 1999) and the reason for this may rest on the ability of firms to collude (Bernheim and Whinston, 1990). But it is not clear that a similar result should hold for potential entrants, as pre-entry and post-entry incentives may differ. Milgrom and Roberts (1982b) suggest that multi-market contact should lead to lower prices when there exists information asymmetry. One possible reason for the lack of lower prices when in multi-market contact with a cable overbuilder is that prior multi-market contact between an incumbent and entrant has acted to reduce information asymmetry over time for a subset of firms that interact primarily with cable overbuilders, and these firms now have less incentive to drop price. In contrast, telecom entrants and incumbents start to interact in the mid 2000s, so even by the end of the dataset (2008) there has only been a few years of interaction between the different firms, so there is still a high probability that information asymmetry persists. Hence, there may still be returns to pricing low to deter telecom overbuilder entry.

While the analyses above used two approaches to identify entry deterring behavior when incumbents face potential entry by telecom overbuilders, the results were significant only when using the temporal variation in state video programming franchises. There was little evidence that the incumbents relied on non-monotonic pricing to deter telecom entry. A possible reason for this result may be that one or more of the model assumptions have been violated. Future work will need to investigate this issue further. In addition, the passage of state video programming franchises was treated as an exogenous event in the empirical section. Future work will need to test this assumption and may rely on an instrument or other technique to deal with any potential endogeneity.

References

Bagwell, Kyle. 1993. "A Model of Competitive Limit Pricing," *Journal of Economics & Management Strategy*, 1(4): 585-606.

Baum, Joel A. C. and Helaine J. Korn. 1999. "Dynamics of Dyadic Competitive Interaction," *Strategic Management Journal* 20(3): 251-278.

Bernhim, B. Douglas and Michael D. Whinston. 1990. "Multimarket Contact and Collusive Behavior," *Rand Journal of Economics*, 21(1): 1-26.

Crandall, Robert, Gregory Sidak and Hal Singer. 2006. "The Competitive Effects of Telephone Entry into Video Markets," Criterion Economics working paper.

Crawford, Gregory. 2006. "Cable Regulation in the Satellite Era" University of Arizona working paper.

Dafny, Leemore. 2005. "Games Hospitals Play: Entry Deterrence in Hospital Procedure Markets," *Journal of Economics and Management Strategy* 14(3): 513-542.

Della Vigna, Stefano and Ethan Kaplan. 2007. "The Fox News Effect: Media Bias and Voting," *Quarterly Journal of Economics* 122: 1187-1234.

Ellison, Glenn and Sara Fisher Ellison. 2007. "Strategic Entry Deterrence and the Behavior of Pharmaceutical Incumbents Prior to Patent Expiration," *NBER working paper number 13069.*

Emmons, William and Robin Prager. 1997. "The Effects of Market Structure and Ownership on Prices and Service Offerings in the US Cable Television Industry," *Rand Journal of Economics*, Vol. 28, No. 4, pp: 732-750.

Gillett, Sharon, William Lehr and Carlos Osorio. 2004. "Local Broadband Initiatives," *Telecommunications Policy* 28: 537-558.

Gillett, Sharon, William Lehr and Carlos Osorio. 2006. "Municipal Electric Utilities' Role in Telecommunications Services," *Telecommunications Policy* 30: 464-480.

Goolsbee, Austan and Amil Petrin. 2004. "The Consumer Gains from Direct Broadcast Satellites and the Competition with Cable TV," *Econometrica* 72(2): 351-381.

Goolsbee, Austan and Chad Syverson. 2008. "How Do Incumbents Respond to the Threat of Entry? Evidence from the Major Airlines," forthcoming *Quarterly Journal of Economics*.

Hauge, Janice, Mark Jamison and Richard Gentry. 2008. "Bureaucrats as Entrepreneurs: Do Municipal Telecommunications Providers Hinder Private Entrepreneurs?" forthcoming *Information Economics and Policy*

Heggestad, Arnold A. and Stephan A. Rhoades. 1978. "Multi-Market Interdependence and Local Market Competition in Banking," *Review of Economics and Statistics* 60(4): 523-532.

Hughes K. and C. Oughton. 1993. "Diversification, Multi-market Contact and Profitability," *Economica* 60:203-224.

Mayo, John W. and Yasuji Otsuka. 1991. "Demand, Pricing and Regulation: Evidence from the Cable TV Industry," *Rand Journal of Economics* 22(3): 396-410.

Milgrom, Paul and John Roberts. 1982a. "Limit Pricing and Entry Under Incomplete Information: An Equilibrium Analysis," *Econometrica* 50(2): 443-459.

Milgrom, Paul and John Roberts. 1982b. "Predation, Reputation and Entry Deterrence," *Journal of Economic Theory* 27: 280-312.

Sappington, David and J. Gregory Sidak. 2003. "Incentives for Anticompetitive Behavior by Public Enterprises," *Review of Industrial Organization*, 22:183-206.

Savage, Scott J. and Michael Wirth. 2005. "Price, Programming and Potential Competition in US Cable Television Markets," *Journal of Regulatory Economics*; 27:1, pp: 25-46.

Schelling, Thomas C. 1960. *The Strategy of Conflict*. Cambridge, MA: Harvard University Press.

Scherer, F. Michael. 1980. *Industrial Market Structure and Economic Performance*. 2nd ed. Chicago, IL: Rand McNally.

Seamans, Robert. 2008. "Entry Deterrence and New Technology Deployment in the Cable TV Industry," UC Berkeley working paper.

Simon, Daniel. 2005. "Incumbent Pricing Responses to Entry," *Strategic Management Journal*, 26: 1229-1248.

Williamson, Oliver E. 1977. "Predatory Pricing: A Strategic and Welfare Analysis," *Yale Law Journal* 87 (2): 284-340.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Monthly Fee ($)	14.75	9.69	0	123.95
Price [Predicted Ln(Monthly Fee+1)]	2.53	0.46	-3.30E-12	4.57
0 Cable Overbuilders in 100 miles	0.56	0.50	0	1
1 Cable Overbuilders in 100 miles	0.16	0.36	0	1
2 Cable Overbuilders in 100 miles	0.06	0.23	0	1
3 Cable Overbuilders in 100 miles	0.05	0.22	0	1
4+ Cable Overbuilders in 100 miles	0.17	0.38	0	1
0 Telecom Overbuilders in 100 miles	0.75	0.44	0	1
1 Telecom Overbuilders in 100 miles	0.17	0.38	0	1
2 Telecom Overbuilders in 100 miles	0.03	0.18	0	1
3 Telecom Overbuilders in 100 miles	0.03	0.16	0	1
4+ Telecom Overbuilders in 100 miles	0.02	0.13	0	1
Multimarket Contact (Cable)	0.38	0.49	0	1
Multimarket Contact (Telecom)	0.15	0.35	0	1
Homes Passed	16967.87	73316.04	9	4100000
Miles of Cable	251.59	786.68	0.3	29791
Municipal Utility	0.16	0.37	0	1
Duopoly	0.01	0.12	0	1
Private Overbuilder	0.01	0.10	0	1
No. Offair Channels	7.88	3.54	1	33
Share of Systems Owned in DMA	0.25	0.22	0.0016	1
Ln (Number of Systems Owned)	6.13	2.23	0.69	8.54
Population per Sq. Mile (County)	206.93	1134.16	0.1	66835
Median Income (County)	33172.88	7717.34	14178	77513
Percent Rural Population	5.69	6.34	0	55

N = 53,507

Table 2: Effect of Municipal Utility on Price

Dependent Variable: price

	I	II	III	IV
Municipal Utility	-0.0095	-0.0220**	-0.0210**	-0.0248**
	[0.0070]	[0.0056]	[0.0055]	[0.0057]
No Cross Subsidy				-0.0101
				[0.0089]
Muni*No Cross Subsidy				0.0275
				[0.0168]
Year Fixed Effects	Y	Y	Y	Y
Service Level Fixed Effects	Y	Y	Y	Y
DMA Fixed Effects	N	Y	Y	Y
System Characteristics	N	N	Y	Y
County Demographics	N	N	Y	Y
Observations	53507	53507	53507	53507
R-squared	0.6018	0.6175	0.6219	0.6220

Robust standard errors in brackets; clustered at state

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 3a: Effect of Telecom Overbuilders within 100 miles on Price

Dependent Variable: price	I	II	III	IV
Potential Telecom Overbuilders >0	0.0148	-0.0024	-0.0042	-0.0035
	[0.0091]	[0.0077]	[0.0078]	[0.0079]
State Franchise				-0.0061
				[0.0232]
State Franchise*Telecom>0				-0.1136**
				[0.0192]
Year Fixed Effects	Y	Y	Y	Y
Service Level Fixed Effects	Y	Y	Y	Y
DMA Fixed Effects	N	Y	Y	Y
System Characteristics	N	N	Y	Y
County Demographics	N	N	Y	Y
Observations	53507	53507	53507	53507
R-squared	0.6023	0.6173	0.6219	0.6220

Robust standard errors in brackets; clustered at state
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 3b: Effect of Telecom Overbuilders within 100 miles on Price

Dependent Variable: price Number of Potential Telecom Overbuilders in 100 Miles	I	II	III
1	0.0106	-0.0023	-0.0041
	[0.0079]	[0.0078]	[0.0081]
2	-0.0057	-0.0142	-0.0167
	[0.0166]	[0.0115]	[0.0113]
3	0.0387	0.0135	0.0123
	[0.0270]	[0.0231]	[0.0237]
4+	0.033	0.0023	0.0009
	[0.0292]	[0.0231]	[0.0211]
Test: Bin2 = Bin4+	0.2361	0.4269	0.3634
Year Fixed Effects	Y	Y	Y
Service Level Fixed Effects	Y	Y	Y
DMA Fixed Effects	N	Y	Y
System Characteristics	N	N	Y
County Demographics	N	N	Y
Observations	53507	53507	53507
R-squared	0.6021	0.6174	0.6220

Robust standard errors in brackets; clustered at state
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 4a: Effect of Cable Overbuilders within 100 miles on Price

	Dependent Variable: price			
	I	II	III	IV
Potential Cable Overbuilders >0	-0.0206*	-0.0051	-0.0078	-0.0116
	[0.0091]	[0.0071]	[0.0068]	[0.0075]
State Franchise				-0.0202
				[0.0227]
State Franchise*Cable>0				0.0296+
				[0.0168]
Year Fixed Effects	Y	Y	Y	Y
Service Level Fixed Effects	Y	Y	Y	Y
DMA Fixed Effects	N	Y	Y	Y
System Characteristics	N	N	Y	Y
County Demographics	N	N	Y	Y
Observations	53507	53507	53507	53507
R-squared	0.6023	0.6173	0.6219	0.6220

Robust standard errors in brackets; clustered at state
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 4b: Effect of Cable Overbuilders within 100 miles on Price

	Dependent Variable: price		
Number of Potential Cable Overbuilders in 100 Miles	I	II	III
1	-0.0193*	-0.0054	-0.0076
	[0.0090]	[0.0074]	[0.0070]
2	-0.0099	-0.0028	-0.0034
	[0.0175]	[0.0100]	[0.0106]
3	-0.0218	-0.0129	-0.017
	[0.0145]	[0.0123]	[0.0124]
4+	-0.0286*	-0.0014	-0.0057
	[0.0124]	[0.0110]	[0.0110]
Test: Bin1 = Bin4+	0.5053	0.6520	0.8355
Year Fixed Effects	Y	Y	Y
Service Level Fixed Effects	Y	Y	Y
DMA Fixed Effects	N	Y	Y
System Characteristics	N	N	Y
County Demographics	N	N	Y
Observations	53507	53507	53507
R-squared	0.6025	0.6173	0.622

Robust standard errors in brackets; clustered at state
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 5a: Effect of Multi-market Contact on Price

Dependent Variable: price

	I		II
Potential Telecom Overbuilders >0	-0.0018	Potential Cable Overbuilders >0	-0.0075
	[0.0079]		[0.0068]
MMC*Potential Telecom Overbuilders >0	-0.0387**	MMC*Potential Cable Overbuilders >0	-0.0097
	[0.0131]		[0.0109]
Test for equality of coefficients:	0.0334	Test for equality of coefficients:	0.8595
Year Fixed Effects	Y	Year Fixed Effects	Y
Service Level Fixed Effects	Y	Service Level Fixed Effects	Y
DMA Fixed Effects	Y	DMA Fixed Effects	Y
System Characteristics	Y	System Characteristics	Y
County Demographics	Y	County Demographics	Y
Observations	53507	Observations	53507
R-squared	0.6225	R-squared	0.6220
Robust standard errors in brackets; clustered at state		Robust standard errors in brackets; clustered at state	
+ significant at 10%; * significant at 5%; ** significant at 1%		+ significant at 10%; * significant at 5%; ** significant at 1%	

Table 5b: Effect of Multi-market Contact on Price

Dependent Variable: price

Number of Potential Telecom Overbuilders in 100 Miles	I	Number of Potential Cable Overbuilders in 100 Miles	II
1	0.0063	1	-0.0007
	[0.0075]		[0.0097]
2	-0.005	2	-0.0057
	[0.0113]		[0.0144]
3	0.0138	3	-0.0099
	[0.0289]		[0.0213]
4+	0.0142	4+	-0.0064
	[0.0257]		[0.0114]
MMC*0	-0.0239+	MMC*0	-0.0063
	[0.0136]		[0.0142]
MMC*1	-0.0703**	MMC*1	-0.0221
	[0.0211]		[0.0152]
MMC*2	-0.0649*	MMC*2	-0.0035
	[0.0303]		[0.0219]
MMC*3	-0.0254	MMC*3	-0.0225
	[0.0315]		[0.0300]
MMC*4+	-0.0665*	MMC*4+	-0.0056
	[0.0254]		[0.0148]
Year Fixed Effects	Y	Year Fixed Effects	Y
Service Level Fixed Effects	Y	Service Level Fixed Effects	Y
DMA Fixed Effects	Y	DMA Fixed Effects	Y
System Characteristics	Y	System Characteristics	Y
County Demographics	Y	County Demographics	Y
Observations	53507	Observations	53507
R-squared	0.6227	R-squared	0.6220
Robust standard errors in brackets; clustered at state		Robust standard errors in brackets; clustered at state	
+ significant at 10%; * significant at 5%; ** significant at 1%		+ significant at 10%; * significant at 5%; ** significant at 1%	

Table 5c: Effect of Multimarket Contact on Price

I		II	
Number of Potential Telecom Overbuilders in 100 Miles	Test for Coefficient Equality (p-values)	Number of Potential Cable Overbuilders in 100 Miles	Test for Coefficient Equality (p-values)
1 1*MMC	0.0024	1 1*MMC	0.3356
2 2*MMC	0.1141	2 2*MMC	0.9523
3 3*MMC	0.4882	3 3*MMC	0.7755
4+ 4+*MMC	0.0999	4+ 4+*MMC	0.9826

Coefficients from Table 5b are tested for equality.

Fig. 1: Distribution of Number of Overbuilders in 100 miles, by Type