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Bridging the Gap between Horizontal and Vertical Merger Simulation: Modifications and Extensions of PCAIDS

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Abstract
A general theoretical and empirical framework is developed for assessing the potential of a vertically integrated firm to foreclose downstream competitors. Using this framework a policymaker may also evaluate the empirical welfare effects from a vertically integrated firm raising rivals' costs. The framework is developed within the context of a vertically integrated multichannel video programming distributor ("MVPD"), and this framework extends the applicability of PCAIDS to vertical mergers. Using public data from the Comcast–Time Warner–Adelphia Merger Order of the Federal Communications Commission, price effects from the threat and action of foreclosure in several designated marketing areas were simulated. Empirical results suggest that the Commission Staff Model substantially underestimated price increases to end users as a result of the threat and action of foreclosure. Empirical results suggest that Commission's Program Access Rules were essential for MVPD competition.

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Keywords Mergers; merger simulation; vertical merger; horizontal merger; telecommunications; PCAIDS; foreclosure; raising rival's cost; two-sided markets

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Introduction and Literature Review

This paper contains a general theoretical and empirical framework that can be used by policy makers to assess the potential for a vertically integrated multichannel video programming distributor ("MVPD") to foreclose downstream competitors from important programming network content. Besides the issue of foreclosure, a policy maker may also use the framework of this paper to evaluate the welfare effects from a vertically integrated MVPD raising rivals' costs. For example, News Corporation Limited ("News Corp.") and DirectTV filed an application to merge that was approved in late 2003. New Corp.'s assets consisted of 35 owned and operated full-powered television broadcast stations, the FOX Broadcast Company, Fox News Channel, Fox Cable Networks, and other video programming assets. DirecTV was an MVPD with 11.4 million subscribers or 13% of all MVPD households. Using DBS satellite technology, DirectTV had a national footprint and competed with every MVPD in every market. During their merger application review, policy makers attempted to determine possible actions of a vertically integrated News Corp-DirecTV in both upstream and downstream markets.[1]

The literature contains theoretical analyses of the potential for a vertically integrated firm to foreclose downstream rivals from important inputs to production. The literature also contains discussions of the theoretical possibility of a vertically integrated firm raising rivals' costs. In both cases consumer welfare effects are discussed. Perry and Groff (1985) assume an upstream monopolist. Downstream, they assume a consumer benefit function that is symmetric in outputs of each product and has constant elasticity of substitution ("CES") between products. There is no income constraint. Each downstream firm produces only one product. A major result of their work is that forward integration by an upstream monopolist reduces welfare. They show that,

[1] See U.S. Federal Communications Commission (2004), "In the Matter of General Motors Corporation and Hughes Electronic Corporation, Transferors And The News Corporation Limited, Transferee, For Authority to Transfer Control." Memorandum Opinion and Order, MB Docket No. 03-124 (released January 14, 2004): 4 -7.

although final prices fall with integration, the welfare gain associated with falling prices is "dwarfed" by the losses from a reduction in product diversity, i.e., fewer differentiated products.

Krattenmaker and Salop (1986) describe foreclosure as restricting the supply to rivals of a key input without similarly restricting the amount of the input that is available to the exclusive purchaser of that input such that rivals' costs are raised. Krattenmaker and Salop identify methods by which foreclosure raises the costs' of rivals. They describe specific methods and conditions in which foreclosure can result in market power in the downstream market for the exclusive purchaser of a key input.

Salinger's (1988) model contains an industry in which there is oligopoly at two success stages of production. In the downstream final good market the equilibrium is Cournot. Unintegrated downstream rivals are assumed to take the price of the upstream input as given. The upstream good market equilibrium is Cournot. Salinger shows that under specific conditions, a vertical merger causes the price of the upstream good to increase. He shows that the increase in the price of the upstream good can dominate the elimination of the double marginalization, and a vertical merger can cause the price of the downstream final good to increase.

To Ordover, Saloner, and Salop (1990) foreclosure results when unintegrated downstream rivals are closed from the input supplies controlled by the firm that integrates. Their model of foreclosure contains to Bertrand competitors in the upstream market. Both competitors produce the same homogeneous input to two downstream competitors. Each downstream firm produces a differentiated product in competition with each other, and initially has equal market shares. Assuming a vertical merger between one supplier and one downstream firm, they examine various scenarios for the way in which input prices are determined. They show that, if downstream firms' revenues are increasing in the price of the input, vertical foreclosure emerges in equilibrium. In their model the profits of the unintegrated downstream firm decrease because it pays the higher input cost.

Chen (2001) presents a model in which downstream firms produce differentiated products. Two downstream firms use a homogeneous input that is produced by two or more upstream firms. Upstream, one firm has a constant marginal cost that is lower than all other firms. In the model, a downstream firm makes relationship-specific investment, i.e., a downstream firm incurs a cost for an arrangement with each additional input supplier. Chen's result is that a vertical merger occurs in equilibrium if and only if one upstream firm has a constant marginal cost that is lower than all other upstream firms. Chen shows that if relationship-specific investment is positive, the vertical merger can cause market foreclosure, raise rivals' costs, and reduce rivals' outputs.

Aside from theoretical results, the literature does not, however, contain a general framework that is consistent with principles of profit maximization or cost minimization and that permits a policy maker to empirically simulate welfare effects from a vertical merger as policy makers may do in cases of horizontal mergers. Indeed, the object of an empirical simulation is to determine the effects of a vertical merger on the welfare of consumers who purchase final goods and services. In an effort to obtain welfare results, policy makers follow and create ad-hoc methodologies that more often follow accounting principles than first principles of economics.[2]

In recent history the Federal Communications Commission ("FCC") analyzed the effects of several vertical mergers on the welfare of consumers. The Commission Staff Model from FCC MB Docket No. 03-124 MEMORANDUM OPINION AND ORDER (December 19, 2003) was used to assess potential vertical harms in the "NewsCorp-DIRECT TV" Transaction. In that model the gains and losses associated with foreclosure of content by a vertically integrated firm were determined. The share of subscribers, "the critical value," that must leave rival MVPDs and

[2] In empirical econometric models equations are specified and statistical methods are used to determine whether the specified model is supported by the data which are assumed to arise from rational and optimizing economic agents. Specific data may support more than one model. In theoretical models that explain the behavior of economic agents, it is assumed that agents behave rationally and optimally, e.g. maximize profit, minimize cost, maximize utility, or some other objective function. Economic efficiency rests on the assumption of agents optimizing. Adhoc means that the modeler ignores and abandons the principle that economic agents behave rationally and optimally.

purchase DIRECTV is such that the gain equals the loss from foreclosure.[3] After critical values were calculated for various markets, econometric analysis was undertaken to estimate "actual critical values" from markets in which critical content was withdrawn by non-vertically integrated firms. If the "actual critical value" was greater than the calculated critical value, then a conclusion was reached that foreclosure would occur and harm would result to consumers in a market. Unfortunately, such analysis is problematic for several reasons. First, the vertically integrated DIERCT TV-NewsCorp was not shown to optimize profits or any optimand when a foreclosure decision was made post-merger. Second, business managers are not likely to behave as Staff's Model represented. With a foreclosure decision by the vertically integrated firm, a manager would be pro-active in making sure the targeted critical value is achieved and/or exceeded. The profit maximizing manager of the vertically integrated firm would likely advertise, adjust quality of service, create new offerings, and/or alter pricing in order to ensure the acquisition of subscribers from rivals.[4] A manager may be aware of an "actual critical value," but in her thinking that "actual critical value" would represent what was done - not what she can do and must do. Indeed, the "actual critical value" may very well be irrelevant to a manager who considers foreclosure an optimal business strategy. Third, Riordan (2008) suggested that the assumptions of Staff Model were asymmetric, i.e., consumers easily switched MVPDs during foreclosure, but after the programming network content was restored, consumers did not have the ability to easily switch MVPDs. Riordan (2008) concluded that "the theory seems odd because it appears to assume that inertia only works one direction, suggesting consumer irrationality." Fourth, the data used to estimate "actual critical values" were for non-vertically integrated content providers. That is, apples and oranges were being compared. Finally, there was an identification

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[3] In the Comcast-NBCU merger review the Critical value is called the departure rate. See Federal Communications Commission, *In the Matter of Applications of Comcast Corporation, General Electric Company and NBC Universal, Inc. Memorandum Opinion and Order, MB Docket No. 10-56, APPENDIX B,* (January 18 2011): 147.

[4] See R. Thomas Umstead, "Kicking Dish in the Pants: MSOs Exploit EchoStar's Brief Loss of SpongeBob and Pals," Multichannel News, March 14 2004. http:/www.multichannel.com/article/59130-Kicking_Dish_In_The_Pants.php

problem in the econometric work because the results did not distinguish whether a buyer of content withdrew from reception of a programming network or whether the seller of content foreclosed the sale of the programming network. Indeed, the separate cases may involve different consumer reactions, responses, and econometric specifications. Because of these identification problems, it is unclear what Staff estimated. Thus, we are left with a completely ad-hoc framework for assessing a vertical merger of an MVPD with a programming network provider.

In a more recent FCC Order concerning the purchase of Adelphia's assets by Comcast and Time Warner, Inc., the Commission pursued a different methodology. In that analysis, the Commission estimated the willingness to pay for a regional sports network ("RSN") with one of the Applicants prior to the transaction and estimated the percentage change in this price following the transaction.[5] In order to determine the maximum willingness to pay of a rival MVPD, the Commission compared the profits that the competing MVPD would earn if it carried the video programming with the profits that it would earn if it did not carry the programming. The Commission determined that the maximum willingness to pay for the programming was the price that would yield the same level of profits regardless of whether the programming was carried.[6] After several simplifying assumptions, the Commission determined that the percentage increase in the uniform price of the Applicant's programming network was equal to the percentage increase in the households that were in the area served by the Applicants cable systems.[7] Unfortunately, this approach is not general and is ad-hoc because it requires the footprint of the vertically integrate MVPD to change in order for price effects to occur during a pricing dispute with a potential threat of foreclosure.

[5] See U.S. Federal Communications Commission (2006), "In the Matter of Application for Consent to Assignment and/or Transfer of Control of Licenses Adelphia Communications Corporation to Time Warner Cable Inc., Adelphia Communications Corporation to Comcast Corporation. " Memorandum Opinion and Order, MB Docket No. 05-192 (released July 21, 2006): 68.

[6] See U.S. Federal Communications Commission (2006), "In the Matter of Application for Consent to Assignment and/or Transfer of Control of Licenses Adelphia Communications Corporation to Time Warner Cable Inc., Adelphia Communications Corporation to Comcast Corporation. " Appendix D, p. 1. Memorandum Opinion and Order, MB Docket No. 05-192 (released July 21, 2006).

[7] Ibid., 2.

Baker (2011) presented an assessment of the Federal Communications Commission's Comcast-NBCU Memorandum Opinion and Order. Baker examines the FCC's evaluation of the possibility of the vertically integrated Comcast and NBCU would obtain or maintain market power in the video distribution market by preventing rival MVPDs from obtaining access to programming network content or by raising the price of that programming. Baker suggests that the work of the FCC provides a roadmap for vertical merger analysis. The work cited by Baker as a road map does, however, contain the same limitations as previous FCC work because the Comcast-NBCU vertical merger analysis fundamentally relied on the FCC's previously discussed ad-hoc methodologies for analyzing foreclosure. Baker (2011) called the FCC Method of foreclosure analysis arithmetic. The use of the term arithmetic is aptly descriptive of the absence of profit maximization, cost minimization, or utility maximization by firms and consumers in the model of foreclosure on which vertical merger analysis was based. With respect to post-merger price changes, the FCC assumed, however, that a rival's cost for NBCU's content increased by half the opportunity cost of the vertically integrated Comcast-NBCU. The post-merger opportunity cost was calculated as half the product of the pre-merger per subscriber profit margin multiplied by the probability that a rival's customer would switch when a rival lost access to NBCU network programming content. This probability was the product of the diversion ratio and the departure rate[8]. While this pricing methodology is an improvement over previous efforts, the methodology fails to capture rational optimizing behavior of economic agents. This is because downstream pre-merger margins are used for opportunity costs instead of post-merger margins. That is optimal profit maximizing prices (price changes) are not calculated by the post-merger firm, and the utility maximizing responses of consumers to post-merger prices are not considered. In addition, the probability that a rival's consumers would switch was based on a historically

[8] Federal Communications Commission, *In the Matter of Applications of Comcast Corporation, General Electric Company and NBC Universal, Inc. Memorandum Opinion and Order, MB Docket No. 10-56, APPENDIX B,* (January 18 2011), p. 156.

calculated departure rate which was characterized by consumer irrationality and other problems previously discussed.

Given the shortcomings of the above empirical analyses, we adopt and modify a standard approach so that the vertical price effects can be quantified. Modification is necessary because an action to foreclose rivals involves more activities by the vertically integrated firm than just withholding programming network content in a MVPD's market. Marketing considerations complementing a foreclosure action are modeled. Following Krattenmaker and Salop's contribution on methods of foreclosure, a method of foreclosure in the context of product differentiation in the upstream programming network content market and product differentiation in the downstream MVPD market is presented. This method rests on the empirical fact that, when programming network content is blacked out/not available to subscribers of the MVPD, e.g., withheld from an MVPD by the programming network provider or removed by the MVPD itself, during a pricing dispute, rivals of that MVPD market and introduce new service offerings and prices to attract subscribers from the foreclosed MPVD. A real market event illustrates this point. In 2000 Time Warner Cable removed ABC stations from cable systems it operated in seven cities serving 3.5 million homes. The removal of the stations arose from the dispute on how much Time Warner should pay Disney for carrying its cable channels. Disney owned ABC. In response to Time Warner's action, Disney offered Time Warner cable subscribers in Houston a $99 rebate on a satellite dish when the two sides faced a deadline for an agreement in Houston. Time Warner lost more than 15,000 subscribers to the offer of Disney, and Time Warner declared the movement of 15,000 plus subscribers was a threat to its business.[9] This "rebate" relationship between Disney and a satellite MVPD suggests that a foreclosure action by a hypothetically vertically integrated Disney-Dish would involve uncertainty for the foreclosing firm, and this firm would offer new services, prices, hardware, and other incentives to subscribers of rivals in

[9] http://articles.sfgate.com/2000-05-02/news/17646617

order to ensure that those subscribers purchase from the foreclosing firm. Moreover, a foreclosure action creates uncertainty for rivals. Quantities demanded for their services become random. Thus, post-merger pricing decisions of all firms are based on expected demands. Using expected demands, Bertrand first-order conditions for the post-merger environment inform modifications to the PCAIDS framework of Epstein and Rubinfeld (2001).

There is the issue of raising a rival's cost. When assessing the possibility of raising rivals' costs, additional modifications are made to PCAIDS. Rising costs of rivals are affected through "efficiency" parameters that are embedded in PCAIDS. These efficiency parameters raise or lower the marginal cost of rivals. Thus, the percentage increase in a rival's end user subscription price is calculated by sequential applications of PCAIDS.

All modifications to PCAIDS are coded in APL. We use public data from the Comcast-Time Warner-Adelphia Merger Order, and we simulate the price effects of the threat and action of foreclosure by the largest applicant in several DMAs. Results from the "vertical" application of modified PCAIDS suggest that the Commission Staff Model substantially understates price increases to end users as a result of the threat and action of foreclosure. In the case of raising a rival's cost, the results suggest that the cost of a rival increased, but improved data may amplify this vertical price effect. These results suggest that the Commission's Program Access Rules were essential for MVPD competition.

This paper is presented in four sections. In Section 1, we formally model a transaction between a non-vertically integrated programming network content provider and an MVPD that provides cable programming networks. The case of foreclosure is modeled, and the separate case of raising rivals costs is modeled. Section 2 contains modifications to PCAIDS of Epstein and Rubinfeld (2001). In Section 3, we apply modified PCAIDS to data from the Comcast-Time Warner-Adelphia transaction. Conclusions are contained in the final section.

Model

Suppose that there are multiple providers of programming network content. Let i, $i = 0,1,2,\ldots, N$, denote a programming network content provider. Suppose that the programming network content market is characterized by competition in differentiated products, i.e., programming network content is a differentiated product. Assume that programming network content of a provider has no marginal cost and a fixed cost which is denoted F_i.[10] That is programming content is a quasi-public good. Providers of programming network content charge MVPDs for their content based on the number of subscribers of a MVPD. The retransmission price or price of programming network content of provider i, is denoted $P_{retrans,i}$. The revenue from providing network programming is a well-behaved concave function $R_i(P_{rettrans,i};N)$ on $P_{retrans,i}$, with N as a parameter. Assume that $\frac{\partial R_i}{\partial N} < 0$.

Suppose that content providers also earn revenue from sales of advertising in their programming network content. Let $P_{Ad,i}$ denote the price of an ad from provider i. The quantity of ads sold is $Q_{Ad,i}(P_{Ad,i})$, and the marginal cost of an ad is denoted $c_{Ad,i}$.[11]

Pre-merger profit of provider i, $i = 0,2,3\ldots, N$, of programming network content is

$$\Pi_i = P_{Ad,i} \times Q_{Ad,i}(P_{Ad,i}) + R_i(P_{retrans,i};N) - c_{Ad,i} \times Q_{Ad,i}(P_{Ad,i}) - F_i \qquad (1)$$

Suppose that for a well defined geographic market there are four $j = 1,2,3,4$, MVPDs competitively distributing video programming content to consumers on a paid-subscription

[10] Programming Network content must be delivered to MVPDs by some distribution mechanism. This means there is likely some positive but infinitesimal marginal cost. When marginal cost is positive, simulation of raising rival's cost is straight forward.

[11] Some MVPDs and all network programming providers compete in two-sided markets. Some MVPs sell cable services to end users, network programming to rival MVPDs, and advertising to businesses or other entities. Because policy makers often probe economic theory for analytic guidance that can inform request for data in merger review, we present a comprehensive treatment of both sides of a relevant market. Where data were available, empirical results are presented for the relevant market.

basis.[12] For simplicity suppose that three of the four MVPDs only distribute video content to subscribers. Let $P_{Sub,j}$ denote the price of subscription for the service of MVPD j. The quantity or number of subscribers to the service of MVPD j is denoted $Q_{sub,j}$. Marginal cost of a subscriber is denoted $c_{sub,i}$. The fixed cost of MVPD j is denoted $F_{MVPD,j}$. The profit of MVPD j is

$$\Pi_{MVPD,j} = P_{Sub,j} \times Q_{sub,j}(P_{Sub,j}) - c_{Sub,j} \times Q_{sub,j}(P_{Sub,j}) - F_{MVPD,j}. \qquad (2)$$

For $j = 1$, the MVPD sells subscriptions to consumers, sells Ads to businesses, and sells cable network programming to other MVPDs. The pre-merger profit of MVPD 1 is

$$\Pi_{MVPD,1} = P_{Sub,1}Q_{sub,1}(P_{Sub,1}) + P_{Ad,1}Q_{Ad,1}(P_{Ad,1}) + R_1(P_{retrans,1}; N) - c_{Sub,1}Q_{sub,1}(P_{Sub,1})$$
$$- c_{Ad,1}Q_{Ad,1}(P_{Ad,1}) - F_{MVPD,1}.$$

<u>Vertical Merger Analysis</u>

Suppose that MVPD 1 proposes to merge with provider $i = 0$ of programming network content. There are several considerations. First, pre-merger first-order conditions in relevant product and geographic markets are presented. Second, when there is the threat and action of foreclosure by the post-merger vertically integrated firm, Bertrand first-order conditions are presented. Third, when there are no threats of foreclosure or foreclosure actions, the post-merger Bertrand conditions for raising rivals costs are presented.

Pre-Merger Environment

Suppose that all firms maximize profits with respect to price(s). For the advertising market the Bertrand first order conditions are:

[12] In some residential areas of Downton Silver Spring, MD, there were four MVPDs. They were DirectTV, Dish, Comcast, RCN, and Verizon.

$$\begin{bmatrix} s_{Ad,0} \\ s_{Ad,1} \\ \vdots \\ s_{Ad,N} \end{bmatrix} + \begin{bmatrix} \overline{\varepsilon_{00}} & 0 & 0 & 0 \\ 0 & \overline{\varepsilon_{11}} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & \overline{\varepsilon_{NN}} \end{bmatrix} \times \begin{bmatrix} s_{Ad,0} & 0 & 0 & 0 \\ 0 & s_{Ad,1} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & s_{Ad,N} \end{bmatrix} \times \begin{bmatrix} \frac{(P_{Ad,0} - c_{Ad,0})}{P_{Ad,0}} \\ \frac{(P_{Ad,1} - c_{Ad,1})}{P_{Ad,1}} \\ \vdots \\ \frac{(P_{Ad,N} - c_{Ad,N})}{P_{Ad,N}} \end{bmatrix} = 0,$$

where $s_{Ad,i}$ is the market share in advertising of provider i of programming network content. The own-price elasticity of demand for ads of provider i of programming network content is $\overline{\varepsilon}_{ii}$. The pre-merger margin of provider i of programming network content is $\frac{(P_{Ad,i} - c_{Ad,i})}{P_{Ad,i}}$.

For the programming network content market the first order conditions are:

$$\frac{\partial R_i}{\partial P_{retrans,i}} = 0, \ i = 0,1,2,\ldots,N.$$

In the relevant geographic market, the pre-merger Bertrand first order conditions result from maximizing the profit of MVPD j with respect to price $P_{sub,j}$. The pre-merger system of Bertrand first order conditions is:

$$\begin{bmatrix} s_{sub,1} \\ s_{sub,2} \\ s_{sub,3} \\ s_{sub,4} \end{bmatrix} + \begin{bmatrix} \varepsilon_{11} & 0 & 0 & 0 \\ 0 & \varepsilon_{22} & 0 & 0 \\ 0 & 0 & \varepsilon_{33} & 0 \\ 0 & 0 & 0 & \varepsilon_{44} \end{bmatrix} \times \begin{bmatrix} s_{sub,1} & 0 & 0 & 0 \\ 0 & s_{sub,2} & 0 & 0 \\ 0 & 0 & s_{sub,3} & 0 \\ 0 & 0 & 0 & s_{sub,4} \end{bmatrix} \times \begin{bmatrix} \frac{(P_{sub,1} - c_{sub,1})}{P_{sub,1}} \\ \frac{(P_{sub,2} - c_{sub,2})}{P_{sub,2}} \\ \frac{(P_{sub,3} - c_{sub,3})}{P_{sub,3}} \\ \frac{(P_{sub,4} - c_{sub,4})}{P_{sub,4}} \end{bmatrix} = 0,$$

where $s_{sub,j}$ is the market share of MVPD j. The own-price elasticity of demand of subscribers for MVPD j is ε_{jj}. The pre-merger margin of MVPD j is $\frac{(P_{sub,j} - c_{sub,j})}{P_{sub,j}}$.

Post-Merger Environment

The post-merge world contains uncertainty. If there are no antitrust activities by the government, what are some ultimate outcomes from foreclosure and/or raising rivals' costs? Joseph A. Schumpeter (1942) suggested that firms compete for the industry. This implies that vertically integrating and withholding an input from rivals can be considered a means of pursuing downstream market power, elimination of rivals, and profit for investment in the Schumperterian process of creative destruction. Even without referring to Schumpeter's work, raising rivals costs can result in rivals exiting the market. If the upstream product is differentiated, if rivals cannot coordinate downstream prices, if barriers to entry by potential downstream competitors are prohibitive, and if rivals' average total cost are driven sufficiently high and the vertically integrated firm sets a price below prices of rivals, all rivals would lose market share and could ultimately be driven from the market. Thus, foreclosure itself or foreclosure that results in raising rivals' costs is completely and logically consistent with the possibility and some positive probability that all rivals could be driven from the downstream market. Using this intuition, the post-merger model follows.

Suppose that the vertically integrated MVPD threatens and carries out a foreclosure action. In the MVPD market there are risks to MVPD1-Programming Network Provider0 ("MVPD1-PN0") from a foreclosure action. The demand arising from a foreclosure action is random. This is because MVPDs' services are differentiated, which means not all MVPDs carry the same content. Loss of vertically integrated MVPD1-PN0's content may not eliminate a rival MVPD from the market. A rival MVPD may respond to foreclosure by lowering subscriber prices or other actions. For MVPD1-PN0 foreclosure means withholding programming network content from rivals and simultaneously marketing in order to attract downstream subscribers from rivals.[13] That is foreclosing in the pursuit of downstream market power is not separable from the act of marketing to attract rival MVPDs' subscribers.

The introduction and marketing of a new service to attract rival MVPDs' subscribers occurs only with a decision to foreclose competitors from upstream content because, in the absence of foreclosure, the vertically integrated firm's optimal pre-merger product mix does not change post-merger. The optimal pre-merger mix of services is optimal post-merger. In the absence of foreclosure nothing occurred in the downstream market that provides incentives for MVPDs to optimally change their mix of network programming services to subscribers. There are no new products entering the relevant market. The work of George and Walfogel (2006) on newspapers provides some intuition. They empirically find that increased availability of the New York Times, a national newspaper, reduces circulation of local newspaper among targeted readers – college educated readers, and the introduction of the national newspaper increases local newspaper readership among individuals not targeted by the times – non-college educated readers. In addition, they find that the local newspaper provides more local and less national coverage in response to the Times expansion. That is the product mix/content mix changed with the introduction of a national newspaper in a local market. Informed by the results of George and Walfogel (2003) and assuming preference externalities in a horizontal merger, Bush and Zimmerman (2010) show that the optimal post-merger mix of programming content will change with post-merger changes in sizes of post-merger groupings of subscribers, e.g., a relative increase in the number subscribers preferring viewing baseball. These results suggest that without upstream foreclosure in the pursuit of downstream market power and other factors unchanged, the newly vertically integrated firm would not alter its service offerings.

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[13] In March 2004 the direct-broadcast satellite operator Dish lost 15 CBS stations and 10 cable channels which were owned by Viacom Inc. Rival MVPDs did their best to exploit the blackout. MVPDs increased the number of buyback plans and quickly created new anti-Dish ads. See R. Thomas Umstead, "Kicking Dish in the Pants: MSOs Exploit EchoStar's Brief Loss of SpongeBob and Pals," Multichannel News, March 14 2004. http:/www.multichannel.com/article/59130-Kicking_Dish_In_The_Pants.php

With this understanding, suppose that MVPD1-PN0 introduces a new differentiated product that is organically tied to the post-merger action of foreclosure, i.e., the necessary service, product, bundle, advertizing, and/or price that attracts rivals' subscribers. Let $P_{sub,f}$ denote the price of the new MVPD service of MVPD1-PN0 that is introduced when rivals are foreclosed. Let Q_f denote the random quantity demanded of this new differentiated service. Let Q_r denote the combined market demand of all rivals of MVPD1. Denote the random variable I such that $I = 1$ if foreclosure action is completely successful, i.e., rivals are eliminated from the market, otherwise $I = 0$. If foreclosure is not completely successful, a denotes MVPD1-Programming Network Provider0's share of rivals' demands. The manager of MVPD1-Programming Network Provider0's prior distribution of I is

$$P(\{I = 1\}) = \alpha$$

$$P(\{I = 0\}) = 1 - \alpha, \text{ where } 0 \leq \alpha \leq 1.$$

$$Q_f = I \times Q_r + (1 - I)aQ_r \Rightarrow$$

$$EQ_f = \alpha \times Q_r + (1 - \alpha)aQ_r$$ [14]

Each competitor faces the threat of foreclosure and a probability that the manager of MVPD1-PN0's foreclosure action will be completely successful. Suppose that all rivals and MVPD1-PN0 have the same prior distribution for the event that foreclosure will be completely successful.[15] For $j = 2,3,4,$ Let I_j denote a random variable such that

[14] Baker (2011) described the process in which the FCC separately modeled foreclosure of each MVPD in a relevant market. The FCC's policy decision, however, relied on evidence of foreclosure for all rivals. The methodology of this paper can also be applied in a limited case of foreclosure of one rival MVPD from the input of the vertically integrated firm. When only one rival MVPD is foreclosed, percentage changes in downstream prices can be determined. If costs rose sufficiently under specific conditions the single rival MVPD could fail, and, hence, a rise in cost is logically associated with a likelihood of failure. One could then successively apply the model to each rival MVPD, and then summarize results as the FCC. Instead, a simpler approach is taken in which the vertically integrated MVPD simultaneously withholds the input from all rivals.

[15] A rival's prior distribution is informed by his knowledge of lost programming networks due to foreclosure. He is aware that his product is altered.

$$I_j = 1 \text{ if foreclosure action is completely successful. } P(I_j) = \alpha$$

$$I_j = 0 \text{ if foreclosure is not completely successful. } P(I_j) = 1 - \alpha$$

If foreclosure is not completely successful, $(1-a)$ denotes the share of rival j 's demand that j retains. Rival j 's random demand is $Q_j = I \times 0 + (1-I)(1-a)Q_{Sub,j} \Rightarrow$

$$EQ_j = q_j = (1-\alpha)(1-a)Q_{Sub,j}$$

Foreclosure affects the ad market. If rivals of MVPD1-PN0 are eliminated in the MVPD market, rivals in the programming content market will have inventories of ads that are not shown to end users. This means that a foreclosure of rival MVPDs implies a potential "shadow foreclosure" in the ad market. Rival programming network content providers ads can only be shown on MVPD1-PN0. Again, assume that MVPD1-PN0 introduces a new differentiated Ad product that is tied to the post-merger action of foreclosure. Let $P_{Ad,f}$ denote the price of the new ad product of MVPD1-PN0. Let $Q_{Ad,f}$ denote the random quantity demanded of this new differentiated ad service. Let $Q_{Ad,r}$ denote the combined market demand of all rivals of MVPD 1-PN0. Denote the random variable I_{Ad} such that $I_{Ad} = 1$

if foreclosure action is completely successful, i.e., rivals are eliminated from the Ad market, otherwise $I_{Ad} = 0$. The manager of MVPD 1-PN0's prior distribution of I_{Ad} is

$$P(\{I_{Ad} = 1\}) = \alpha_{Ad}$$

$$P(\{I_{Ad} = 0\}) = 1 - \alpha_{Ad}.$$

The share of rivals' customers who purchase ads from MVPD1-PN0 in the event $\{I_{Ad} = 0\}$ is a_{Ad}, and this parameter is the share of MVPD1-PN0's ad market demand prior to foreclosure action in the MVPD market. Thus,

$$Q_{Ad,f} = I_{Ad} \times Q_{Ad,r} + (1 - I_{Ad}) \times a_{Ad} \times Q_{Ad,r}.$$

$$EQ_{Ad,f} = q_{Ad,f} = \alpha_{Ad} \times Q_{Ad,r} + (1-\alpha_{Ad}) \times a_{Ad} \times Q_{Ad,r}.$$

Suppose that in the Ad market all rivals and MVPD1-PN0 have the same prior distribution for the event that foreclosure will be completely successful, i.e., MVPD1-PN0 will drive other programming network content providers out of the advertising business because of MVPD1-PN0's foreclosure action in the MVPD market. For $i = 2,3,\ldots,N,$ Let $I_{Ad,i}$ denote a random variable such that $I_{Ad,i} = 1$ if shadow foreclosure action in the ad market is completely successful. $P(\{I_{Ad,i} = 1\}) = \alpha_{Ad}$. If shadow foreclosure in the Ad market is not completely successful, $I_{Ad,i} = 0$. That is $P(\{I_{Ad,i} = 0\}) = 1 - \alpha_{Ad}$.

If shadow foreclosure is not completely successful, $(1 - a_{Ad})$ denotes the share of rival i's demand that i retains. Rival i's random demand is

$$\hat{Q}_{Ad,i} = I_{Ad,i} \times 0 + (1 - I_{Ad,i})(1 - a_{Ad})Q_{Ad,i} \Rightarrow$$

$$E\hat{Q}_{Ad,i} = q_{Ad,i} = (1-\alpha_{Ad})(1-a_{Ad})Q_{Ad,i}$$

The post-merger profit of MVPD 1-PPN0 0 is a random variable

$$\Pi_{MVPD1-PN0} = P_{Sub,1}Q_{sub,1}(P_{Sub,1}, P_{Sub,f}) + P_{Sub,f}Q_{sub,f}(P_{Sub,1}, P_{Sub,f}) + P_{Ad,0} \times Q_{Ad,0}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f})$$

$$+ P_{Ad,1}Q_{Ad,1}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) + P_{Ad,f} \times Q_{Ad,f}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) + R_0(P_{retrans,0}, P_{retrans,1}; N-1)$$

$$+ R_1(P_{retrans,0}, P_{retrans,1}; N-1) - c_{Sub,1}Q_{sub,1}(P_{Sub,1}, P_{Sub,f}) - c_{Sub,f}Q_{sub,f}(P_{Sub,1}, P_{Sub,f})$$

$$- c_{Ad,0} \times Q_{Ad,0}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) - c_{Ad,1}Q_{Ad,1}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) - c_{Ad,f}Q_{Ad,f}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) - F_{MVPD,1} - F_0$$

The expected profit of the vertically integrated firm is

$$E\Pi_{MVPD1-PN0} = P_{Sub,1}Q_{sub,1}(P_{Sub,1}, P_{Sub,f}) + P_{Sub,f}q_{sub,f}(P_{Sub,1}, P_{Sub,f}) + P_{Ad,0} \times Q_{Ad,0}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f})$$

$$+ P_{Ad,1}Q_{Ad,1}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) + P_{Ad,f} \times q_{Ad,f}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) + R_0(P_{retrans,0}, P_{retrans,1}; N-1)$$

$$+ R_1(P_{retrans,0}, P_{retrans,1}; N-1) - c_{Sub,1}Q_{sub,1}(P_{Sub,1}, P_{Sub,f}) - c_{Sub,f}q_{sub,f}(P_{Sub,1}, P_{Sub,f})$$

$$- c_{Ad,0} \times Q_{Ad,0}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) - c_{Ad,1}Q_{Ad,1}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) - c_{Ad,f}q_{Ad,f}(P_{Ad,0}, P_{Ad,1}, P_{Ad,f}) - F_{MVPD,1} - F_0$$

Expected post-merger profit of provider i, $i = 2,3\ldots,N$, of programming network content is

$$\Pi_i^{Post} = P_{Ad,i} \times q_{Ad,i}(P_{Ad,i}) + R_i(P_{retrans,i}; N-1) - c_{Ad,i} \times q_{Ad,i}(P_{Ad,i}) - F_i$$

Expected post-merger profit of MVPD j, $j = 2,3,4$, is

$$\Pi_{MVPD,j}^{Post} = P_{Sub,j} \times q_j(P_{Sub,j}) - c_{Sub,j} \times q_j(P_{Sub,j}) - F_{MVPD,j}.$$

Before post-merger Bertrand first-order conditions are derived, relationships between expected elasticities of demand and actual market elasticities of demand are clarified in Lemmas 1 through 4 of Appendix 1. The lemmas show that expected elasticities are equal to actual elasticities.

Bertrand first-order conditions are derived for the three markets.

Let * denote post-merger equilibrium values.

Propositions 1, 2 and 3 contain results.

Proposition 1. Suppose there is a threat and foreclosure action by MVPD1-PN0. Suppose that MVPD1-PN0 maximizes $E\Pi_{MVPD1-PN0}$ with respect to prices. Suppose that provider i of programming network content maximizes Π_i^{Post} with respect to $P_{Ad,i}$ and $P_{retrans,i}$, then the post-merger Bertrand first-order conditions for advertising are

$$\begin{bmatrix} s^*_{Ad,0} \\ s^*_{Ad,1} \\ s^*_{Ad,f} \\ s^*_{Ad,2} \\ \vdots \\ s^*_{Ad,N} \end{bmatrix} + \begin{bmatrix} \bar{\varepsilon}^*_{00} & \bar{\varepsilon}^*_{10} & \bar{\varepsilon}^*_{f0} & 0 & 0 & 0 \\ \bar{\varepsilon}^*_{01} & \bar{\varepsilon}^*_{11} & \bar{\varepsilon}^*_{f1} & 0 & 0 & 0 \\ \bar{\varepsilon}^*_{0f} & \bar{\varepsilon}^*_{1f} & \bar{\varepsilon}^*_{ff} & 0 & 0 & 0 \\ 0 & 0 & 0 & \bar{\varepsilon}^*_{22} & 0 & 0 \\ 0 & 0 & 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & 0 & 0 & \bar{\varepsilon}^*_{NN} \end{bmatrix} \times \begin{bmatrix} s^*_{Ad,0} & 0 & 0 & 0 & 0 & 0 \\ 0 & s^*_{Ad,1} & 0 & 0 & 0 & 0 \\ 0 & 0 & s^*_{Ad,f} & 0 & 0 & 0 \\ 0 & 0 & 0 & s^*_{Ad,2} & 0 & 0 \\ 0 & 0 & 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & 0 & 0 & s^*_{Ad,N} \end{bmatrix} \begin{bmatrix} \frac{(P^*_{Ad,0} - c^*_{Ad,0})}{P^*_{Ad,0}} \\ \frac{(P^*_{Ad,1} - c^*_{Ad,1})}{P^*_{Ad,1}} \\ \frac{(P^*_{Ad,f} - c^*_{Ad,f})}{P^*_{Ad,0}} \\ \frac{(P^*_{Ad,f} - c^*_{Ad,f})}{P^*_{Ad,f}} \\ \vdots \\ \frac{(P^*_{Ad,N} - c^*_{Ad,N})}{P^*_{Ad,N}} \end{bmatrix} = 0$$

where $s^*_{Ad,i}$ is the expected market share in advertising of provider i of programming network content. The own-price elasticity of demand for ads of provider i of programming network content is $\bar{\varepsilon}^*_{ii}$. The cross-price elasticity of demand of i with respect to l is $\bar{\varepsilon}^*_{il}$.

Proposition 2. Suppose that MVPD1-PN0 maximizes $E\Pi_{MVPD1-PN0}$ with respect to prices and that provider i of programming network content maximizes Π_i^{Post} with respect to $P_{Ad,i}$ and $P_{retrans,i}$, then the post-merger first-order conditions for programming network content are

$$\begin{bmatrix} \frac{\partial R_0}{\partial P_{retrans,0}} \\ \frac{\partial R_0}{\partial P_{retrans,1}} \\ \frac{\partial R_1}{\partial P_{retrans,0}} \\ \frac{\partial R_1}{\partial P_{retrans,1}} \\ \frac{\partial R_2}{\partial P_{retrans,2}} \\ \vdots \\ \frac{\partial R_N}{\partial P_{retrans,n}} \end{bmatrix} = 0$$

Proposition 3. Suppose that MVPD1-PN0 maximizes $E\Pi_{MVPD1-PN0}$ with respect to prices. Suppose that MVPD j maximizes $\Pi^{Post}_{MVPD,j}$ with respect to $P_{Sub,j}$, then the post-merger Bertrand first-order conditions for MVPD subscribers are

$$\begin{bmatrix} s^*_{sub,1} \\ s^*_{sub,f} \\ s^*_{sub,2} \\ s^*_{sub,3} \\ s^*_{sub,4} \end{bmatrix} + \begin{bmatrix} \varepsilon^*_{11} & \varepsilon^*_{f1} & 0 & 0 & 0 \\ \varepsilon^*_{1f} & \varepsilon^*_{ff} & 0 & 0 & 0 \\ 0 & 0 & \varepsilon^*_{22} & 0 & 0 \\ 0 & 0 & 0 & \varepsilon^*_{33} & 0 \\ 0 & 0 & 0 & 0 & \varepsilon^*_{44} \end{bmatrix} + \begin{bmatrix} s^*_{sub,1} & 0 & 0 & 0 & 0 \\ 0 & s^*_{sub,f} & 0 & 0 & 0 \\ 0 & 0 & s^*_{sub,2} & 0 & 0 \\ 0 & 0 & 0 & s^*_{sub,3} & 0 \\ 0 & 0 & 0 & 0 & s^*_{sub,4} \end{bmatrix} \begin{bmatrix} \dfrac{(P^*_{sub,1} - c^*_{sub,1})}{P^*_{sub,1}} \\ \dfrac{(P^*_{sub,f} - c^*_{sub,f})}{P^*_{sub,f}} \\ \dfrac{(P^*_{sub,2} - c^*_{sub,2})}{P^*_{sub,2}} \\ \dfrac{(P^*_{sub,3} - c^*_{sub,3})}{P^*_{sub,3}} \\ \dfrac{(P^*_{sub,4} - c^*_{sub,4})}{P^*_{sub,4}} \end{bmatrix} = 0$$

where $s^*_{sub,j}$ is the expected market share subscribers of MVPD j. The own-price elasticity of demand for subscribers of MVPD service j is ε^*_{jj}. The cross-price elasticity of expected demand of j with respect to l is ε^*_{jl}.

Modifications to PCAIDS.

Foreclosure

Modifications to PCAIDS are made in order to determine the percentage change in MVPD subscriber prices in a post-vertical merger environment characterized by foreclosure. The modifications follow the work of Bush and Zimmerman (2008) and are contained in Algorithm V-1.

The solution to Proposition 2 or Proposition 3 may be found below. The algorithm is cast in terms of Proposition 3. In order to implement Algorithm V-1, two results of Epstein and Rubinfeld (2001) are needed. First, the PCAIDS own-price elasticity of demand for the i-th brand (ε_{ii}) can be expressed as

$$\varepsilon_{ii} = -1 + \frac{b_{ii}}{s_i} + s_i(\varepsilon + 1) \tag{1}$$

and the cross-price elasticity of demand between the i-th and j-th brands (ε_{ij}) as

$$\varepsilon_{ij} = \frac{b_{ij}}{s_i} + s_j(\varepsilon + 1) \tag{2}$$

where

$\varepsilon =$ industry (market) price elasticity of demand,

$b_{ii} =$ own-effect (AIDS) coefficient for brand *i*,

$b_{ij} =$ cross-effect (AIDS) coefficient between brands *I* and *j*,

$s_i =$ market (revenue) share of good *i*, and

$s_j =$ market (revenue) share of good j.[16]

The following can be shown.

Suppose that θ_j, $j = 1, \ldots, n$, is the percentage change in unit cost/marginal cost. If θ_j is known then $(1+\theta_j) \times \left(\frac{1-\mu_j^{pre}}{1-\mu_j^{post}} \right) = \frac{p_j^{post}}{p_j^{pre}}$.

[16] Knowledge of only the industry elasticity and the own-price elasticity of the *i*-th brand is sufficient to calculate the own-effect coefficient of the *i*-th brand; specifically:

$$b_{ii} = s_i(\varepsilon_{ii} + 1 - s_i(\varepsilon + 1)).$$

Further, the authors show that the proportionality assumption implies that all of the remaining unknown own-effect coefficients can be determined as single multiples of b_{ii}, or

$$b_{jj} = \frac{s_j}{1-s_i} \frac{1-s_j}{s_i} b_{ii},\ \forall i \neq j.$$

Let B_{N-1} be the set of brands such that brand j is excluded, and $b_{ij} = \frac{-s_i}{\sum_{i \in B_{N-1}} s_i} \times b_{jj}$.

AlgorithmV-1 (Foreclosure). *Let t denote the iteration in the algorithm.*

Pre-Merger Calculations

[1] Given initial market shares, a market elasticity, and a brand own-price elasticity, calculate (i) B.

(ii) $\mu^{\mathrm{Pre}} = -S_o^{-1} \times E_o^{-1} \times s_o$, *where* $s_o = \begin{bmatrix} s_{sub,1} \\ s_{sub,2} \\ s_{sub,3} \\ s_{sub,4} \end{bmatrix}$. The matrix

$$S_o = \begin{bmatrix} s_{sub,1} & 0 & 0 & 0 \\ 0 & s_{sub,2} & 0 & 0 \\ 0 & 0 & s_{sub,3} & 0 \\ 0 & 0 & 0 & s_{sub,4} \end{bmatrix}, \quad \mu^{\mathrm{Pre}} = \begin{bmatrix} \dfrac{(P_{sub,1} - c_{sub,1})}{P_{sub,1}} \\ \dfrac{(P_{sub,2} - c_{sub,2})}{P_{sub,2}} \\ \dfrac{(P_{sub,3} - c_{sub,3})}{P_{sub,3}} \\ \dfrac{(P_{sub,4} - c_{sub,4})}{P_{sub,4}} \end{bmatrix}, \text{ and}$$

$$E_o = \begin{bmatrix} \varepsilon_{11} & 0 & 0 & 0 \\ 0 & \varepsilon_{22} & 0 & 0 \\ 0 & 0 & \varepsilon_{33} & 0 \\ 0 & 0 & 0 & \varepsilon_{44} \end{bmatrix}.$$

Post-Vertical Merger Calculations

[2] Assuming vertical integration with the introduction of a product to affect foreclosure and given initial expected market shares, a market elasticity, and a brand own-price elasticity, calculate B_1 *and* $\mu_1^{V\,\mathrm{Pre}} = -S_1^{-1} \times E_1^{-1} \times s_1$. *The matrix* B_1 *reflects the introduction of a new product and is computed analogously to* B . *The vector* $s_1 = \begin{bmatrix} s^o_{sub,1} \\ s^o_{sub,f} \\ s^o_{sub,2} \\ s^o_{sub,3} \\ s^o_{sub,4} \end{bmatrix}$ contains the initial

expected shares. The matrix S_1 is a diagonal matrix of initial expected shares. The matrix E_1 is a matrix of initial elasticities and reflects the introduction of the new product. After vertical integration with foreclosure, the vector of initial expected margins is $\mu_1^{V\,\mathrm{Pre}}$, *and* $P_j^{V\,\mathrm{Pre}}$ *is the expected price.*

[3] For $t = 2,3,4,\ldots$ *until satisfied, execute in order (i),...,(v):*

(i) Calculate $\mu_t^{post} = S^{-1}(\mu_{t-1}^{post}) \times E^{-1}(\mu_{t-1}^{post}) \times s(\mu_{t-1}^{post})$

(ii) Calculate $\dfrac{P_{j,t}^{post}}{P_j^{V\,\mathrm{Pre}}} = (1+\theta_j) \times \left(\dfrac{1-\mu_j^{V\,\mathrm{Pre}}}{1-\mu_{j,t}^{post}} \right).$

(iii) Calculate $\delta_t = (\ln(\dfrac{P_{1,t}^{post}}{P_1^{V\,\mathrm{Pre}}}),,\ldots,\ln(\dfrac{P_{4,t}^{post}}{P_4^{V\,\mathrm{Pre}}}))'.$

(iv) Calculate $s(\mu_t^{post}) = s_1 + B_1\delta_t$

(v) Calculate $E^{-1}(\mu_t^{post})$ *assuming the market elasticity is unchanged.*

Until satisfied means "until first-order conditions are satisfied." This also means convergence of $\mu^{post.}$

[4] *Calculate* $\dfrac{P_{j,t}^{post}}{P_j^{pre}} = (1+\theta_j) \times \left(\dfrac{1-\mu_j^{pre}}{1-\mu_{j,t}^{post}} \right)$, $\theta_j = 0$ and $j \neq f$.

<u>Raising Rivals' Costs</u>

Suppose that post-merger foreclosure is not a concern, there would remain an opportunity to raise rivals' costs as suggested by Proposition 2. Because of the quasi-public good nature of programming network content an algorithm is developed to approximate optimum prices using Proposition 2. If there were, however, some positive marginal cost, Proposition 2 would be transformed into nominal Bertrand first-order conditions. For example, the Wireline Telecommunications Industry contains a Special Access Product Market. Special Access services are used by wireline competitors, wireless firms, and OSPs for building their networks and for connecting to networks of other firms. Some services in Special Access are DS1, DS3, and OC3. There are also positive marginal costs associated with Special Access. Given a market elasticity of demand and an own-price elasticity of demand for a brand of service, PCAIDS can be used to determine percentage increases in Special Access prices in a post-merger situation. Since Special Access services are inputs to networks that may compete with a provider of Special Access in an appropriate geographic market, percentage increases in Special Access prices can inform efficiency parameters of PCAIDS which affect marginal cost in expressions for margins. Thus, given information on marginal costs (average variable costs as approximations) for end user services which rely on Special Access, PCAIDS could be sequentially used to determine the percentage increase in prices of end user services. Similar logic would apply to programming network content if there were some positive marginal cost. Instead, Proposition 2 suggests a direction.

Assume that $\frac{\partial R_i}{\partial N} < 0 \Rightarrow$ bargaining strength of MVPD1-PN0 increases post-merger.

Suppose that post-merger the MVPD1-PN0 is able to extract from MVPD j, $j = 2,3,4$ a share of the pre-merger per-channel average profit margin. This assumption will provide a lower bound to an increase in rival j 's cost.

To implement Algorithm V-2 below, the number of channels ς_j of MVPD j, and the marginal cost, and pre-merger revenue of j are required.[17]

AlgorithmV-2 (Raising Rival's Cost).

Pre-Merger

[1] Given initial market shares, a market elasticity, and a brand own-price elasticity, calculate (i) B

$$(ii)\ \mu^{\text{Pre}} = -S_o^{-1} \times E_o^{-1} \times s_o .$$

[17] One could use average variable cost as an approximation of marginal cost. If elasticties and price data are available, one could calculate an implied marginal cost.

[2] For $j = 2,3,4$ average profit per channel per subscriber as

$$\frac{(P^o_{sub,j} - c^o_{sub,j})}{P^o_{sub,j}} \times R^o_j \times \frac{1}{\varsigma_j} \times \frac{1}{Q_{sub,j}}.$$

Let $m^o_j = \frac{(P^o_{sub,j} - c^o_{sub,j})}{P^o_{sub,j}}$ which is calculated in *[1] (ii)*.

Post-Merger

[3] MVPD1-PN0 and MVPD j bargain and settle at Nash bargaining solution[18] such that MVPD1-PN0 is paid an additional post-merger amount of

$$\frac{1}{2} \times \frac{(P^o_{sub,j} - c^o_{sub,j})}{P^o_{sub,j}} \times R^o_j \times \frac{1}{\varsigma_j} \times \frac{1}{Q_{sub,j}} = \frac{1}{2} \times m^o_j \times P^o_{sub,j} \times \frac{1}{\varsigma_j}.$$

[4] Calculate $c^*_j = c^o_{sub,j} + \frac{1}{2} \times m^o_j \times P^o_{sub,j} \times \frac{1}{\varsigma_j}.$

[5] Calculate efficiency parameter $\theta_j = \frac{c^*_j - c^o_{sub,j}}{c^o_{sub,j}} = \frac{1}{2} \times m^o_j \times P^o_{sub,j} \times \frac{1}{\varsigma_j} \times \frac{1}{c^o_{sub,j}}.$

[6] For $t = 1,2,\ldots$ until satisfied, execute in order (i), ...,(v):

(i) calculate $\mu^{post}_t = -S^{-1}(\mu^{post}_{t-1})E^{-1}(\mu^{post}_{t-1})s(\mu^{post}_{t-1})$

(ii) calculate $\frac{p^{post}_{j,t}}{p^{pre}_j} = (1+\theta_j) \times \left(\frac{1-\mu^{pre}_j}{1-\mu^{post}_{j,t}}\right)$

(iii) calculate $\delta_t = (\ln(\frac{p^{post}_{1,t}}{p^{pre}_1}),\ldots,\ln(\frac{p^{post}_{n,t}}{p^{pre}_n}))'$

(iv) calculate $s(\mu^{post}_t) = s_o + B\delta_t$

(v) calculate $E^{-1}(\mu^{post}_t)$ *assuming the market elasticity is unchanged.*

[18] See Drew Fudenberg and Jean Triole, Game Theory 117 (1991).

Until satisfied means "until first-order conditions are satisfied." This also means convergence of μ^{post}. Initial values in the iterative process are pre-merger values.

Application of Theory and Algorithms:
Comcast-Time Warner- Adelphia Transaction.

This model of foreclosure and Algorithm V-1 are applied to data from the Comcast-Time Warner-Adelphia Transaction of 2006. In that transaction both Comcast and Time Warner purchased Aldelphia's MVPD assets.[19] The Commission found that "the transaction would enable Comcast and Time Warner to raise the price of access to Regional Sports Networks ("RSNs") by imposing uniform price increases applicable to all MVPDs, including their own systems … by permanently or temporarily withholding programming."[20] The economic analysis of the Commission Staff focused, however, on the narrower issue of whether a vertically integrated RSN had an incentive to increase its price when there was an increase in the size of the MVPD with which it is integrated.[21] Therefore, the model of this paper is used to test the Commission's conclusion on permanent foreclosure.

In Table A-2 of Appendix D of the Commission's Order, data were provided on the Percentage of Homes Passed by the Largest Applicant for key DMAs. Because market share data from the transaction were not public data, it is assumed that in a DMA the percentage of homes passed for the largest applicant is a reasonable approximation for the market share of the largest applicant. We assume that there are at least two competitors in a DMA. There is a composite DBS provider and the incumbent cable provider. Given data and our foreclosure model, Algorithm V-1 was applied to ten (10) DMAs of varying sizes and from different sections of the United States. Because data on ad shares were not published, this analysis only assesses the affect of the transaction on subscriber prices.

[19] See FCC (2006) "Comcast-Time Warner-Adelphia Memorandum Opinion and Order." (July 21, 2006).
[20] Ibid., 57.
[21] Ibid., Appendix D, p 1.

In order to apply Algorithm V-1, which is a modification of PCAIDS, several inputs are required. A market elasticity of demand and a single brand elasticity of demand were necessary inputs. Treating cable in a DMA as a generic brand, elasticities were taken from the work of Goolsbee and Petrin (2004). They published an own-price elasticity of demand of -3.175 for premium cable. As suggested by Epstein and Rubinfeld, a market elasticity of demand of -1 was assumed. The largest cable applicant's market share was used for a. Finally, a prior probability of the largest applicant completely eliminating the composite DBS rival from the market was required. Because the market consists of differentiated products, conservatively assume that the prior probability of the largest applicant completely succeeding in a foreclosure action is zero. Finally, as a result of threats and an action of foreclosure the percentage increase in end user subscriber prices for both cable and DBS are presented in Table 1.

Table 1: Foreclosure: $\alpha = 0$

Buffalo

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	8.03627	0
Cable Foreclose	1.71549	-9.49577	0
Satellite	0	0	-10.75176

Buffalo	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	78.7%	78.7%	31.5%	68.5%	68.5%	117.5%	78.7%
Cable Foreclose	n/a	16.8%	n/a	68.5%	68.5%	n/a	16.8%
Satellite	21.3%	4.5%	11.1%	9.3%	9.3%	-1.9%	4.5%

Cincinnati

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	3.53366	0
Cable Foreclose	1.34724	-5.36142	0
Satellite	0	0	-5.88091

Cincinnati	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	61.9%	61.9%	31.5%	54.7%	54.7%	51.3%	61.9%
Cable Foreclose	n/a	23.6%	n/a	54.7%	54.7%	n/a	23.6%
Satellite	38.1%	14.5%	22.1%	17.0%	17.0%	-6.1%	14.5%

Green Bay

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	3.31742	0
Cable Foreclose	1.3137	-5.17872	0
Satellite	0	0	-5.63112

Green Bay	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	60.4%	60.4%	31.5%	53.7%	53.7%	48.0%	60.4%
Cable Foreclose	n/a	23.9%	n/a	53.7%	53.7%	n/a	23.9%
Satellite	39.6%	15.7%	23.2%	17.8%	17.8%	-6.6%	15.7%

Philadelphia

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	8.28173	0
Cable Foreclose	1.7226	-9.73413	0
Satellite	0	0	-11.00433

Philadelphia	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	79.2%	79.2%	31.5%	68.9%	68.9%	119.9%	79.2%
Cable Foreclose	n/a	16.5%	n/a	68.9%	68.9%	n/a	16.5%
Satellite	20.8%	4.3%	10.7%	9.1%	9.1%	-1.8%	4.3%

San Francisco

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	21.99167	0
Cable Foreclose	1.97925	-23.18742	0
Satellite	0	0	-24.97092

San Francisco	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	91.0%	91.0%	31.5%	83.6%	83.6%	318.5%	91.0%
Cable Foreclose	n/a	8.2%	n/a	83.6%	83.6%	n/a	8.2%
Satellite	9.0%	0.8%	4.3%	4.0%	4.0%	-0.4%	0.8%

Memphis, TN

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	2.81353	0
Cable Foreclose	1.2267	-4.76183	0
Satellite	0	0	-5.04023

Memphis, TN	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	56.4%	56.4%	31.5%	51.3%	51.3%	40.7%	56.4%
Cable Foreclose	n/a	24.6%	n/a	51.3%	51.3%	n/a	24.6%
Satellite	43.6%	19.0%	26.2%	19.8%	19.8%	-8.0%	19.0%

Boston

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	13.1419	0
Cable Foreclose	1.86615	-14.45075	0
Satellite	0	0	-16.00805

Boston	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	85.8%	85.8%	31.5%	76.4%	76.4%	190.3%	85.8%
Cable Foreclose	n/a	12.2%	n/a	76.4%	76.4%	n/a	12.2%
Satellite	14.2%	2.0%	7.1%	6.2%	6.2%	-0.9%	2.0%

Milwaukee

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	6.59516	0
Cable Foreclose	1.6356	-8.13456	0
Satellite	0	0	-9.23076

Milwaukee	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	75.2%	75.2%	31.5%	65.0%	65.0%	95.5%	75.2%
Cable Foreclose	n/a	18.6%	n/a	65.0%	65.0%	n/a	18.6%
Satellite	24.8%	6.2%	13.2%	10.8%	10.8%	-2.6%	6.2%

San Diego

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	0.80038	0
Cable Foreclose	0.58508	-3.3903	0
Satellite	0	0	-2.3854

San Diego	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	26.9%	26.9%	31.5%	38.6%	38.6%	11.6%	26.9%
Cable Foreclose	n/a	19.7%	n/a	38.6%	38.6%	n/a	19.7%
Satellite	73.1%	53.4%	55.5%	41.9%	41.9%	-23.5%	53.4%

Washington DC

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	1.84533	0
Cable Foreclose	0.99833	-4.02201	0
Satellite	0	0	-3.84366

Washington DC	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
1	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	45.9%	45.9%	31.5%	45.9%	45.9%	26.7%	45.9%
Cable Foreclose	n/a	24.8%	n/a	45.9%	45.9%	n/a	24.8%
Satellite	54.1%	29.3%	35.1%	26.0%	26.0%	-12.3%	29.3%

Results contained in Table 1 suggest that the Commission was correct in concluding that permanent foreclosure would increase consumer prices and produce harm. The results suggest significant price increases to consumers under foreclosure. A rival responds, however, to foreclosure by reducing the price of its differentiated product. In Cincinnati, Green Bay, Memphis, San Diego, and Washington, DC, DBS prices are reduced by more than 5% in response to foreclose. The quality of DBS service is, however, lower due to withheld content.[22]

Sensitivity of simulation results was examined. Table 2 contains results where $\alpha = 0.025$. That is managers believed there was a 2.5% chance that rivals would be driven from the relevant market when the vertically integrated firm's programming network content was withheld.

[22] One could easily model and empirically implement the possibility of a rival introducing a new differentiated product in response to foreclosure.

Table 2: Foreclosure: $\alpha = 0.025$

Buffalo

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	8.03627	0
Cable Foreclose	1.7257	-9.48556	0
Satellite	0	0	-10.76197

Buffalo	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	78.7%	78.7%	31.5%	69.0%	69.0%	121.0%	78.7%
Cable Foreclose	n/a	16.9%	n/a	69.0%	69.0%	n/a	16.9%
Satellite	21.3%	4.4%	11.1%	9.3%	9.3%	-2.0%	4.4%

Cincinnati

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	3.53366	0
Cable Foreclose	1.36437	-5.34429	0
Satellite	0	0	-5.89803

Cincinnati	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	61.9%	61.9%	31.5%	55.2%	55.2%	53.0%	61.9%
Cable Foreclose	n/a	23.9%	n/a	55.2%	55.2%	n/a	23.9%
Satellite	38.1%	14.2%	22.1%	17.0%	17.0%	-6.1%	14.2%

Green Bay

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	3.31742	0
Cable Foreclose	1.33466	-5.15777	0
Satellite	0	0	-5.65208

Green Bay	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	60.4%	60.4%	0.31496	0.54338	0.543378	50.0%	60.4%
Cable Foreclose	n/a	24.3%	n/a	0.54338	0.543378	n/a	24.3%
Satellite	39.6%	15.3%	0.23162	0.17693	0.176925	-6.6%	15.3%

Philadelphia

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	8.28173	0
Cable Foreclose	1.73582	-9.72091	0
Satellite	0	0	-11.01755

Philadelphia	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	79.2%	79.2%	0.31496	0.69484	0.694839	124.5%	79.2%
Cable Foreclose	n/a	16.6%	n/a	0.69484	0.694839	n/a	16.6%
Satellite	20.8%	4.2%	0.10774	0.09076	0.090764	-1.9%	4.2%

San Francisco

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	21.99167	0
Cable Foreclose	1.98167	-23.185	0
Satellite	0	0	-24.9733

San Francisco	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	91.0%	91.0%	0.31496	0.83799	0.837989	322.8%	91.0%
Cable Foreclose	n/a	8.2%	n/a	0.83799	0.837989	n/a	8.2%
Satellite	9.0%	0.8%	0.04349	0.04004	0.040043	-0.4%	0.8%

Memphis, TN

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	2.81353	0
Cable Foreclose	1.25212	-4.73641	0
Satellite	0	0	-5.06565

Memphis, TN	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	56.4%	56.4%	0.31496	0.52005	0.520054	42.7%	56.4%
Cable Foreclose	n/a	25.1%	n/a	0.52005	0.520054	n/a	25.1%
Satellite	43.6%	18.5%	0.26222	0.197408	0.197408	-8.1%	18.5%

Boston

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	13.1419	0
Cable Foreclose	1.87387	-14.44303	0
Satellite	0	0	-16.01577

Boston	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	85.8%	85.8%	0.31496	0.76856	0.768563449	196.0%	85.8%
Cable Foreclose	n/a	12.2%	n/a	0.76856	0.768563449	n/a	12.2%
Satellite	14.2%	2.0%	0.07071	0.06244	0.062438449	-0.9%	2.0%

Milwaukee

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	6.59516	0
Cable Foreclose	1.64909	-8.12108	0
Satellite	0	0	-9.24425

Milwaukee	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	75.2%	75.2%	0.31496	0.65534	0.65534	98.8%	75.2%
Cable Foreclose	n/a	18.8%	n/a	0.65534	0.65534	n/a	18.8%
Satellite	24.8%	6.0%	0.13166	0.10818	0.10818	-2.6%	6.0%

San Diego

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	0.80038	0
Cable Foreclose	0.62482	-3.35055	0
Satellite	0	0	-2.4252

San Diego	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	26.9%	26.9%	0.31496	0.39213	0.39213	12.7%	26.9%
Cable Foreclose	n/a	21.0%	n/a	0.39213	0.39213	n/a	21.0%
Satellite	73.1%	52.1%	0.55544	0.41234	0.41234	-24.4%	52.1%

Washington DC

Post-Merger-Foreclosure Initial Elasticities

Elasticity	Cable	Cable Foreclose	Satellite
Cable	-3.175	1.84533	0
Cable Foreclose	1.02774	-3.99259	0
Satellite	0	0	-3.87307

Washington DC	Original	Expected	Margin	Expect Margin	Margin	%Change	Post-Foreclose
	Share	Share	Pre-Merger	Post-Merger	Post-Merger	Price	Share
Cable	45.9%	45.9%	0.31496	0.46571	0.46571	28.2%	45.9%
Cable Foreclose	n/a	25.6%	n/a	0.46571	0.46571	n/a	25.6%
Satellite	54.1%	28.5%	0.35145	0.25819	0.25819	-12.6%	28.5%

With α increasing from 0 to 0.025 there were higher welfare loses in all markets. The vertical integrated firm's original program bundle's percentage price change increased by 1.1 percentage points in San Diego and by a high of 5.7 percentage points in Boston.

When α increased from 0 to 0.025., rivals in Buffalo, Philadelphia, Memphis, San Diego, and Washington, DC made slightly deeper price cuts. For both values of α rivals cut prices to remain competitive, but rivals did so with an inferior quality bundle which did not contain the programming network content of the vertically integrated firm. This result is akin to Perry and Groff (1985) in that rivals' prices were reduced and rivals' service bundle's lost diversity in programming network content. As suggested by Krattenmaker and Salop (1986) costs of rivals increased. In order to remain competitive, a rival reduced price on a lower quality product. Krattenmaker and Salop demonstrated that such action resembles a marginal cost increase.

In order to apply Algorithm V-2, information on the marginal cost of a rival in DMA is required. Such data were not published, however Algorithm V-2 can be easily implemented by using implied marginal costs for the premium services of DIRECT TV and EchoStar. Premium services are selected for two reasons. First, the own-price elasticity of demand from Goolsbee and Pertin (2004) was for premium cable. Second, because MVPDs paid a per subscriber price for the right to re-transmit the content of a programming network provider, the larger the program bundle sold to subscribers the higher the marginal cost of that bundle. Thus, any possible rise in a specific programming network's share of this marginal cost would provide a reasonable lower bound on the percentage increase in the marginal costs of DIRECT TV and EchoStar.

For illustrative purposes the Buffalo DMA and the Memphis DMA were analyzed. For Buffalo and Memphis the Comcast-Time Warner-Adelphia Order did not contain data on DIRECT TV's and EchoStar's market shares in those DMAs. In each DMA national market shares for both DIRECT TV and EchoStar were used to disaggregate the DBS share contained in the Comcast-Time Warner-Adelphia Order.[23] National data on DBS market share were taken from the Thirteenth Annual Report[24] and presented in Table 3.

TABLE 3		
	National DBS Subs	National DBS Subs Percentage
DIRECT TV	15,510,000	54.5%
EchoStar	12,460,000	43.8%
Sky Angel	500,000	1.8%
Total	28,470,000	100.0%

In the Buffalo DMA, the share of cable is 78.7% and the share of DBS is 21.3%. The number of programming network channels and price(s), $P^{o}_{sub,j}$, were taken from the Thirteenth Annual Report. Disaggregated shares and results for raising rivals' costs are contained in Table 3.

Table 4 Raising Rival's Cost: Buffalo

Pre-Merger Matrix of Elasticities

	Cable	Direct TV	EchoStar	Sky Angel
Cable	-3.175	0	0	0
Direct TV		-10.0268	0	0
EchoStar	0	0	-10.2596	0
Sky Angel	0	0	0	-11.1725

Buffalo	Disaggregate MVPD Shares	Pre-Merger Margin	Pre-Merger Price	Implied Marginal Cost	Program Channels	Efficiency Theta
Cable	78.70%	0.31496				
Direct TV	11.60%	0.09973	99.99	90.0179973	250	0.000221556
EchoStar	9.32%	0.09747	89.99	81.2186747	281	0.000192164
Sky Angel	0.38%	0.08951				
Total	100.00%					

Buffalo	Post-Merger MVPD Share	Post-Merger Price Percentage Change
Cable	78.735%	0.000%
Direct TV	11.579%	0.022%
EchoStar	9.306%	0.019%
Sky Angel	0.380%	0.000%

[23] See FCC (2006) "Comcast-Time Warner-Adelphia Memorandum Opinion and Order." (July 21, 2006).

[24] See U.S. Federal Communications Commission (2007), "In the Matter of Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming." Thirteenth Annual Report, MB Docket No. 06-189 (adopted November 27, 2007): 40.

Both DIRECT TV's and EchoStar's costs and end user prices increased. Their shares decreased, while the share of Cable increased. The price of Cable did not change.

In the Memphis DMA, the share of cable was 56.4% and the share of DBS was 43.6%. The number of programming network channels and prices were taken from the Thirteenth Annual Report. Disaggregated shares and results for raising rivals costs are contained in Table 5.

Table 5 Raising Rival's Cost: Memphis

Pre-Merger Matrix of Elasticities

	Cable	Direct TV	EchoStar	Sky Angel
Cable	-3.175	0	0	0
Direct TV		-4.80376	0	0
EchoStar	0	0	-5.03672	0
Sky Angel	0	0	0	-5.95012

Memphis	Disaggregate MVPD Shares	Pre-Merger Margin	Pre-Merger Price	Implied Marginal Cost	Program Channels	Efficiency Theta
Cable	56.40%	0.31496				
Direct TV	23.75%	0.20817	99.99	79.1750817	250	0.000525795
EchoStar	19.08%	0.19854	89.99	72.1233854	281	0.000440788
Sky Angel	0.77%	0.16806				
Total	100.00%					

Memphis	Post-Merger MVPD Share	Post-Merger Price Percentage Change
Cable	56.459%	0.000%
Direct TV	23.712%	0.053%
EchoStar	19.058%	0.044%
Sky Angel	0.710%	0.000%

In Memphis both DIRECT TV's and EchoStar's costs and end user prices increased. Their shares decreased, while the share of Cable increased. The price of Cable did not change.

Conclusion

Ad-hoc empirical methodologies are generally used to estimate the welfare effects of a merger that consists of integrating an upstream supplier of an input with a downstream producer of a product for consumers. This paper contains a general methodology that is consistent with economic theory and permits a policy maker to simulate percentage changes in consumer prices in a post-vertical-merger environment. This empirical methodology can be used to assess the case of foreclosure and the case of raising rivals cost. For the case of foreclosure the methodology rests on the recognition that there is uncertainty surrounding demand during the period of foreclosure and that, because of uncertainty, new products/services are offered by the post-merger vertically integrated firm in order to capture customers of rivals. With this understanding, PCAIDS is modified in order to simulate foreclosure in which a new product is introduced by the post-merger vertically integrated firm. Rivals respond to foreclosure with price changes. Using public data from the Comcast-Time Warner-Adelphia transaction, permanent foreclosure was analyzed with the model and associated empirical algorithm. The results suggest that there were significant increases in the prices of the post-merger vertically integrated firms. Downstream rivals respond, however, with prices decreases. In half of the Designated Marketing Areas, rivals reduced prices by more than 5%. The quality of rivals DBS service was lower due to lost programming network content. An extension of the model and analysis would permit downstream rivals to also introduce a new product or service during the period of foreclosure. Such a modification can be easily accommodated.

For the case of raising rival's cost, an algorithm is presented such that PCAIDS could be sequentially applied in order to determine welfare effects. First, given pre-merger downstream market share data, revenue data, and marginal cost data for a rival (average variable cost as an approximation or implied marginal costs), PCAIDS can be used to determine pre-merger margins of a rival. Then, bargaining theory is used to determine the share of the pre-merger margin per channel per consumer that the post-merger vertically integrated firm takes. This is a lower bound on the gain to the vertically integrated firm and on the incremental cost to a specific rival. Given this rise in cost to a rival, PCAIDS was modified in order to assess the percentage change in prices to consumers in the post-vertical-merger environment. Using public data from the Thirteenth Annual Report of the Commission, Algorithm V-2 was applied to both the Buffalo DMA and the Memphis DMA. Rivals' costs rose and the prices of DIRECT TV and EchoStar subscribers increased. Both Companies lost market shares, while cable companies gained market share without price increases. Consumer welfare was reduced. In summary this paper presents a simple, consistent, and more direct methodology for assessing the welfare effects of vertical merger between upstream network content providers and downstream MVPDs.

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Appendix 1

In this appendix expected elasticities are shown to be equal to actual elasticities. Lemma 1 follows.

Lemma 1. If $EQ_f = q_f = \alpha \times Q_r + (1-\alpha)aQ_r$, then $\frac{P_{Sub,f}}{q_f}\frac{\partial q_f}{\partial P_{Sub,f}} = \frac{P_{Sub,f}}{Q_r}\frac{\partial Q_r}{\partial P_{Sub,f}}$, and $\frac{P_{Sub,1}}{q_f}\frac{\partial q_f}{\partial P_{Sub,1}} = \frac{P_{Sub,1}}{Q_r}\frac{\partial Q_r}{\partial P_{Sub,1}}$.

Proof: $\frac{\partial q_f}{\partial P_{Sub,f}} = [\alpha + (1-\alpha)a] \times \frac{\partial Q_r}{\partial P_{Sub,f}} \Rightarrow$

$$\frac{\partial P_{Sub,f}}{\partial q_f}\frac{\partial q_f}{\partial P_{Sub,f}} = [\alpha + (1-\alpha)a] \times \frac{P_{Sub,f}}{[\alpha + (1-\alpha)a] \times Q_r} \times \frac{\partial Q_r}{\partial P_{Sub,f}} \Rightarrow \frac{P_{Sub,f}}{Q_r} \times \frac{\partial Q_r}{\partial P_{Sub,f}} = \varepsilon_{ff}$$

Now, $\frac{\partial q_f}{\partial P_{Sub,1}} = [\alpha + (1-\alpha)a] \times \frac{\partial Q_r}{\partial P_{Sub,1}} \Rightarrow$

$$\frac{\partial P_{Sub,1}}{\partial q_f}\frac{\partial q_f}{\partial P_{Sub,1}} = [\alpha + (1-\alpha)a] \times \frac{P_{Sub,1}}{[\alpha + (1-\alpha)a] \times Q_r} \times \frac{\partial Q_r}{\partial P_{Sub,1}} \Rightarrow \frac{P_{Sub,1}}{Q_r} \times \frac{\partial Q_r}{\partial P_{Sub,1}} = \varepsilon_{f1}$$

Q.E.D.

Lemma 1 simply states that the expected own-price elasticity of the new service offering is equal to the actual own-price elasticity. Moreover, the expected cross-price elasticity of the new service offering is equal to the actual cross-price elasticity.

Lemma 2. If $EQ_j = q_j = (1-\alpha)(1-a)Q_{Sub,j}$, $j = 2,3,4$, then $\frac{P_{Sub,j}}{q_j}\frac{\partial q_j}{\partial P_{Sub,j}} = \frac{P_{Sub,j}}{Q_{sub,j}}\frac{\partial Q_{sub,j}}{\partial P_{Sub,j}} = \varepsilon_{jj}$.

Proof: $\frac{\partial q_j}{\partial P_{Sub,j}} = [(1-\alpha)(1-a)] \times \frac{\partial Q_{sub,j}}{\partial P_{Sub,j}} \Rightarrow$

$$\frac{P_{Sub,j}}{q_j}\frac{\partial q_j}{\partial P_{Sub,j}} = \frac{P_{Sub,j}}{[(1-\alpha)(1-a)] \times Q_{sub,j}}[(1-\alpha)(1-a)] \times \frac{\partial Q_{sub,j}}{\partial P_{Sub,j}} = \frac{P_{Sub,j}}{Q_{Sub,j}}\frac{\partial Q_{Sub,j}}{\partial P_{Sub,j}} = \varepsilon_{jj}$$

Q.E.D.

Lemma 3. If $EQ_{Ad,f} = q_{Ad,f} = [\alpha_{Ad} + (1-\alpha_{Ad}) \times a_{Ad}] \times Q_{Ad,r}$, then
$\frac{P_{Ad,s}}{q_{Ad,f}} \frac{\partial q_{Ad,f}}{\partial P_{Ad,s}} = \frac{P_{Ad,s}}{Q_{Ad,r}} \frac{\partial Q_{Ad,r}}{\partial P_{Ad,s}} = \bar{\varepsilon}_{fs}, \quad s = 0,1,f.$

Proof: For $s = 0,1,f$, $\frac{\partial q_{Ad,f}}{\partial P_{Ad,s}} = [\alpha_{Ad} + (1-\alpha_{Ad}) \times a_{Ad}] \times \frac{\partial Q_{Ad,r}}{\partial P_{Ad,s}} \Rightarrow$

$$\frac{P_{Ad,s}}{q_{Ad,f}} \frac{\partial q_{Ad,f}}{\partial P_{Ad,s}} = \frac{P_{Ad,s}}{[\alpha_{Ad} + (1-\alpha_{Ad}) \times a_{Ad}] \times Q_{Ad,r}} [\alpha_{Ad} + (1-\alpha_{Ad}) \times a_{Ad}] \times \frac{\partial Q_{Ad,r}}{\partial P_{Ad,s}} = \frac{P_{Ad,s}}{Q_{Ad,r}} \frac{\partial Q_{Ad,r}}{\partial P_{Ad,s}} = \bar{\varepsilon}_{fs}$$

Q.E.D.

This means that the expected elasticities of demand of the new ad product of MVPD1-PN0 are equal to the actual market elasticities.

Lemma 4. If $E\hat{Q}_{Ad,i} = q_{Ad,i} = (1-\alpha_{Ad})(1-a_{Ad})Q_{Ad,i}$, $i = 2,3,\ldots,N$, then
$\frac{P_{Ad,i}}{q_{Ad,i}} \frac{\partial q_{Ad,i}}{\partial P_{Ad,i}} = \frac{P_{Ad,i}}{Q_{Ad,i}} \frac{\partial Q_{Ad,i}}{\partial P_{Ad,i}} = \bar{\varepsilon}_{ii}.$

Proof: The proof is analogous to the proof of Lemma 3. Q.E.D.

Under Lemma 4, the expected elasticity of demand for an ad from a rival programming network provider is equal to the actual market elasticity of demand for an ad.

Proposition 1.

Proof: Given Lemma 3 and Lemma 4, the proof is obvious. Take derivatives and solve for Bertrand conditions.

Proposition 2.

Proof: Obvious.

Proposition 3.

Proof: Given Lemma 1 and Lemma 2, the proof is obvious. Take derivatives and solve for Bertrand conditions.