Effects of Vertical Integration in the NBC-Comcast Merger

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Introduction

In this paper I hope to provide a useful summary of much of the literature relevant to the Comcast-NBC merger particularly regarding the effects of the vertical components of the merger. This literature incorporates both academic papers as well as the Federal Communications Commission’s antitrust proceedings following the merger proposal. Utilizing pertinent literature and models discussed in the literature review I then seek to develop a model of my own that applies more specifically to the Comcast-NBC case being considered. The primary purpose of the model I develop is to incorporate some of the new regulations adopted by the Federal Communication Commission, required for their approval of the merger, in my analysis. The ultimate goal of this paper is to examine the effects of the regulations adopted by the FCC regarding anticompetitive issues arising from the merger and conclude whether consumers stand to benefit from the transaction.

Literature Review

In 2010 NBC and Comcast (collectively referred to as the “applicants”) applied to merge into a joint venture. This merger was very significant because it allowed NBC Universal’s broadcast television networks (NBC and Telemundo), 26 broadcast television stations and cable programming to come under control of Comcast. This represents a merger of one of the largest television content creators with the nation’s largest cable operator and Internet service provider, creating a $30 billion media powerhouse (FCC 11-4, pg. 3). Obviously a merger of such scale quickly attracted antitrust attention and the Federal Communications Commission set about examining whether the transaction
served the public interest. Several concerns were raised in this examination that will be further explored in this paper. Namely, the Commission considered whether the merger would allow the applicants to use their control over video programming to harm competing Multichannel Video Programming Distributors (MVPDs) by withholding content or raising programming prices, hinder the development of online video distribution, or employ anticompetitive tactics with their control over video distribution to deny unaffiliated video programmers access to Comcast subscribers or impose unreasonable terms for distribution on their systems (FCC 11-4, pg. 13).

The merger comes at a very interesting time technologically. We are just now witnessing the development and evolution of a still very young Online Video Distribution (OVD) network. Services such as Hulu, Comcast’s XFinity TV and others soon to be launched such as Google TV allow more flexibility than ever to watch shows where and when people desire. Interestingly, traditional television distribution through cable networks required content creators (NBC, ABC, etc.) to work with the content distributors (cable networks, satellite TV, etc.) to reach their audience. However, online video distribution benefits from net neutrality rules that require Internet service providers to treat all traffic equally. As a result, content creators now have the ability to directly reach their audience and forego negotiations with content distributors. Some people have resultanty viewed this merger as an attempt by Comcast to remain relevant in the traditional television game and hinder the development of online video distribution services by obtaining control of a large portion of the media creation industry. It is important to note that the applicants have an incentive to harm online providers since these providers pose a threat to Comcast’s MVPD business and the merged entity can
make decisions based on the combined interests of NBC and Comcast. In contrast, non-vertically merged content creation competitors make decisions based on the interests of themselves only, not their distribution partners. For this reason, these non-vertically merged entities have an interest in promoting the growth of online video distributors since they represent a potential additional or alternative distribution channel. As a result, the Federal Communications Commission determined that Comcast-NBCU “must offer its programming on terms comparable to those offered by its non-vertically integrated peers, which lack Comcast-NBCU’s incentive to harm online providers” (FCC 11-4, pg. 36).

The above discussion follows fairly straightforwardly from traditional economic theory. Essentially, you have upstream firms (the content producers) and downstream firms (the content distributors). Assume at the start that both the upstream and downstream industries are oligopolistic, that is firms in each earn profits greater than zero and therefore possess some market power. In the Federal Communication Commission’s analysis of the merger they came to conclude that online video distribution represented a potential substitute (especially in the future) of traditional MVPD services. Therefore, as the OVD industry develops these new distributors represent additional distribution platforms for the content producers and, in turn, make the distribution industry more competitive than before the introduction of OVD services, holding MVPD providers constant. As the downstream distributors increase in number and become more competitive each of these firms loses market power and the upstream firms gain market power (assuming the number of upstream firms is held constant). For this reason, it is in
the interest of the content producers to stimulate the growth of the OVDs and against the interests of traditional MVPDs.

One of the most heavily debated issues in the merger antitrust deliberations was that of foreclosure. With Comcast’s control of NBCU it was asserted that they could limit the NBCU programming available to competing video distributors or raise the prices in an anticompetitive fashion to give Comcast a comparative advantage over unintegrated distributors. Foreclosure with differentiated products is a complex issue but in essence, Comcast could give itself preferential treatment by raising the cost of obtaining programming for other video distributors or provide for differentiation of services by creating NBCU programming available only through Comcast. In contrast, Comcast-NBCU asserted that the merger would eliminate double-marginalization and that they would have no incentive to foreclose competitors from NBCU programming.

Michael Salinger demonstrates in his paper “Vertical Mergers and Market Foreclosure” three effects of a vertical merger in an industry in which each stage is oligopolistic, and vertically integrated as well as unintegrated producers coexist. Some of his assumptions do not quite apply to the NBCU-Comcast case (such as homogenous intermediate and final goods), but the general framework of his model and his conclusions are certainly worth considering. Salinger considers a simple game in which intermediate and final goods are homogenous and produced with constant returns to scale. The equilibrium in the final good market is Cournot and demand for the final good is linear. Further, the intermediate good market equilibrium is also Cournot and is based on the demand curve faced by the unintegrated intermediate good producers. One key assumption underlying these standard demand curve assumptions is that “the unintegrated
upstream producers move first and the final good (both unintegrated and integrated) producers move second” (Salinger 349). Interestingly, under this model the effect of vertical mergers on the final good price is indeterminate. For one, a vertical merger eliminates what is often referred to as “double marginalization.” That is, the intermediate good producer will typically mark up their intermediate good to earn a profit and then the final good producer will further mark up the good to earn a profit as well. As a result, a good can be sold for a lower price and/or higher quantity making consumers better off and increasing total profit if the two entities were to merge. The vertical merger under this model caused the merged firm to produce more of the final good than the previously unintegrated final good producer, causing the residual demand curve facing the remaining unintegrated final producers as well as their demand for the intermediate good to shift back – driving the intermediate good price down. However, the merger also eliminates an independent supplier of the intermediate good which can cause the price of the intermediate good to increase (and in turn, causes the final price to increase since the remaining unintegrated final good producers are now less competitive). As a result, the final effect on pricing is indeterminate as either effect can dominate even under the restrictive assumptions of Salinger’s model. “Obviously, if the price can go either up or down in a special case, it can also go either way under more general assumptions” (Salinger 350). Therefore, under a model more closely related to the NBC-Comcast merger we can expect that, depending on the exact assumptions made, both intermediate good and final good prices could potentially be expected to either increase or decrease. For this reason, we must be cognizant of the assumptions we utilize and sensitivity analysis with these assumptions is likely a worthy effort.
Another interesting paper to consider is “Equilibrium Vertical Foreclosure” by Janusz A. Ordover, Garth Saloner, and Steven Salop (referred to as Salop & Saloner going forward). Unlike the Salinger model, the model in this paper further explores foreclosure theory - particularly the incentives of the integrated firm and unintegrated input supplier to exclude rivals and counterstrategies of competitors to foreclosure threats. In order to analyze these effects Salop & Saloner considered a four-stage model with a successive duopoly at the start. The two upstream firms equally split the market and each provide a homogenous input to two downstream firms that then produce a differentiated product competing with one another. At the start both final good producers have equal share of the market. The model intentionally ignores double marginalization so as to focus exclusively on foreclosure and so assumes Bertrand competition in both phases. For this reason, before a merger the upstream firms compete the price to marginal cost since they are selling homogenous goods and the downstream firms use prices as strategic variables. The best response functions of each downstream firm are derived as a function of input price, marginal cost of producing the final good, and the derivative of demand for the firm’s product with respect to its price. These best response functions imply that the firm’s optimal price of the final good will increase as the cost of the intermediate good increases. This implication seems straightforward but assuming normal inputs is necessary. Salop & Saloner also assume the prices of the two final goods are strategic complements – meaning the optimal price for one final goods firm increases if the other firm increases their price, holding all else constant. This is satisfied when downstream demands are linear.
Within the model, there are four firms: U1 & U2 – the upstream firms, and D1 & D2 – the downstream firms. The first stage is a bidding stage in which the two downstream firms bid to take over one of the upstream suppliers. If there is a merger it is assumed to occur between D1 and U1, and the combined entity shall become F1. In the second stage input prices are determined, which is a crucial stage in the game. It is safe to assume that if D1 and U1 merge that D1 continues to obtain the input at true marginal cost to the upstream firm but it is possible for a few different outcomes for D2. F1 and U2 could simultaneously choose input prices while competing via Bertrand, F1 could commit to not supplying D2 at all (in which case the only alternative D2 has to obtaining the input is producing it itself at some cost), or F1 can set an upper bound on the price D2 faces by offering to supply at some price greater than marginal cost. The first option of competing via Bertrand is not in the best interest of the merged firm since they will compete input prices to marginal cost and D2 will obtain the input at a cheaper price than had F1 not sold the intermediate good at all. The second option potentially endows monopoly power to U2 depending on the cost of D2 producing the input itself, and the third option allows F1 to limit U2’s market power. In the third stage, if D1 acquired U1, D2 can bid to purchase U2 (counterstrategies). In the final stage, downstream prices are determined based on the input prices. Using this model, Salop & Saloner conclude that the central requirement for successful foreclosure to take place is simply that the unintegrated upstream firm’s gain exceeds the downstream firm’s loss. This is so because under these conditions, the downstream firm is not willing to pay the upstream firm as much as the upstream firm stands to gain by remaining independent. This is an important distinction in foreclosure theory since it does not only incorporate input prices or final
output but rather considers many of the strategic options available to firms and helps to more completely explain why foreclosure is successful in some cases.

In the FCC deliberations they determined that foreclosure was a very realistic threat as a result of the merger and enacted new legislation in order to prevent the applicants from abusing their new market power. The Commission determined Comcast already had a history of utilizing foreclosure strategies in the past when they had less ability and incentive to do so (FCC 11-4, pg. 14). Further, “the record shows that the loss of Comcast-NBCU programming, including the programming contributed by NBCU, would harm rival video distributors, reducing their ability or incentive to compete with Comcast for subscribers” and is “particularly true for marquee programming” (FCC 11-4, pg. 17). Comcast could even use the threat of foreclosure to obtain a higher price in negotiations. However, Comcast contends that NBCU only controls 12.8% of MVPD program network revenues and this limited fraction of upstream inputs would be insufficient to harm rivals. Also, the applicants assert that their fiduciary duty to GE, which remains a shareholder in NBCU, “will eliminate its ability to engage in exclusionary strategies that benefit Comcast’s video distribution business at the expense of its programming business” (FCC 11-4, pg. 15). Despite these claims, the Commission has long considered vertical integration a threat and even previously passed legislation prohibiting exclusive contracts for any vertically integrated programming since competing MVPDs need access to the vertically integrated programming in order to be considered viable substitutes by consumers. Furthermore, there exist exclusionary strategies that would not violate NBCU’s fiduciary duty to GE such as Comcast-NBCU raising the cost of programming to Comcast and Comcast rivals at the same time. This
would shift profits from Comcast to the Comcast-NBCU joint venture and would not violate previous pre-merger FCC regulations. Additionally, these anticompetitive exclusionary strategies would often be profitable for Comcast according to the FCC deliberations, implying they would likely occur absent regulation. In order to resolve these perceived issues, the Commission decided to impose “baseball-style arbitration to maintain the pre-integration balance of bargaining power between vertically integrated programming networks and rival MVPDs” (FCC 11-4, pg. 22). The mechanism they created essentially allows an upset MVPD to submit a dispute with Comcast-NBCU over the terms of carriage of Comcast-NBCU programming. An arbitrator then chooses between the final contract offers proposed by the complainant MVPD and Comcast-NBCU based upon which offer best reflects fair market value of the programming. This new regulation is incredibly important for the analysis in this paper as we will analyze the effects of the mechanism and determine whether it successfully prevents foreclosure.

Before we begin the analysis one more assumption inherent in the model should be explained. We will assume throughout that a vertically integrated firm makes decisions on a firm-wide basis. That is, the vertically integrated firm determines the optimal intermediate and final goods price based on the profit earned by the entire merged entity as opposed to just the upstream or downstream division. This is a simple and intuitive assumption but it is not by any means arbitrary.

In the Fershtman & Judd paper “Equilibrium Incentives in Oligopoly,” they examine the incentives inherent in owner-manager relationships between competing firms. While it is often assumed a firm maximizes its own profit, managers who make pricing decisions usually have incentive schemes tied to certain output statistics that may
or may not be the overall profit of the firm. Interestingly, they find that in equilibrium managers are paid in excess of their decision’s marginal profit in a Cournot game and are paid less than the marginal profit of their decisions in a game in which prices are the strategic variables. This is because the incentive scheme offered to the manager is a strategic variable of the owners and it may be in the interest of the owners to distort his manager’s incentives away from maximizing the owner’s welfare if the reaction of the owner’s competitors is beneficial (Fershtman 928). Fershtman & Judd then construct a two-stage game with two firms that each have an owner and manager. In the first stage the owners know the probability distributions governing demand and costs and choose a compensation scheme for their managers. In the second stage the managers determine strategy for pricing or quantities (depending on whether price or quantities are the strategic variables) and then the owners observe the profits of the firm. They find that owner’s will distort the incentives of their managers in the direction that will cause opposing firms to change their behavior in beneficial directions. Under Cournot (quantity) competition the owners will essentially offer the managers a transfer price greater than marginal cost and under Bertrand (price) competition the owners will offer the managers a transfer price less than marginal cost in order to make them commit to being more aggressive. Bonanno & Vickers have even found that in some instances a manufacturer can earn higher profits under vertical separation than being vertically integrated since it encourages more friendly behavior from their manufacturing competitor.
Data & Hypothesis

We hypothesize that the model laid forth in the following section will suggest that the FCC regulations are necessary to prevent the Applicants from abusing their market power and may even be sufficient.

Analysis

We will begin with a model that involves just 1 upstream firm (U1) and 2 downstream firms (D1 & D2). After considering the base case we will incorporate a mechanism that replicates the effects of the FCC legislation and analyze its effects. We will eventually examine the effects of the mechanism in the general case where there are N_I upstream firms, N_F downstream firms, and n mergers.

Some important notation used throughout the analysis:

\( N_I \) = Number of intermediate good producers
\( N_F \) = Number of final good producers
\( n \) = Number of vertically integrated firms
\( Q_F \) = Total output of the final good
\( Q_U \) = Total output of unintegrated final good producers (and therefore total output of unintegrated intermediate good producers)
\( Q_{VI} \) = Total output of vertically integrated firms
\( q_i \) = output of firm \( i \)

The inverse demand curve for the final good is \( P_F = a - bQ_F \)


**Base Case – U1, D1 & D2**

We will now consider a game in which there is just 1 upstream firm (U1) and 2 downstream firms (D1 & D2).

Stage 1: U1 Announces $P_I$ (the input price)

Stage 2: D1 & D2 choose $q_1$ and $q_2$

We will consider this the Base Case since no merger will take place and no regulations are in place. We assume linear demand $P_F = a - bQ$ where $Q = q_1 + q_2$

We begin by solving the game in reverse. The two downstream firms take $P_I^*$ as given and we can predict their best response functions in terms of $P_I$

$$\pi_{D_1} = (a - bQ - P_I^* - MC_F)q_1$$

$$\pi_{D_1} = (a - b(q_1 + q_2) - P_I^* - MC_F)q_1$$

$$\pi_{D_2} = (a - b(q_1 + q_2) - P_I^* - MC_F)q_2$$

$$\frac{d\pi_{D_1}}{dq_1} = a - 2bq_1 - bq_2 - P_I^* - MC_F = 0$$

$$2bq_1 = a - bq_2 - P_I^* - MC_F$$

$$q_1 = \frac{a - bq_2 - P_I^* - MC_F}{2b}$$

and $q_2 = \frac{a - bq_1 - P_I^* - MC_F}{2b}$ by symmetry

Plug $q_2$ into the equation for $q_1$ and we get

$$q_1 = \frac{a - b\left(\frac{a - bq_1 - P_I^* - MC_F}{2b}\right) - P_I^* - MC_F}{2b}$$
Which can be simplified to

\[ q_1 = \frac{a - P^*_I - MC_F}{3b} \]

and

\[ q_2 = \frac{a - P^*_I - MC_F}{3b} \] by symmetry again

These are the downstream firms’ best response functions. We can now use these to set up a maximization problem for \( U_1 \) that can then be solved for in terms of \( P^*_I \):

\[ \pi_{U_1} = (P_I - MC_I)(Q) \]

\[ \pi_{U_1} = (P_I - MC_I)(2 \times \frac{a - P^*_I - MC_F}{3b}) \]

\[ \frac{d\pi_{U_1}}{dP_I} = \frac{2}{3b} \left( a - 2P^*_I - MC_F + MC_I \right) = 0 \]

\[ P^*_I = \frac{a - MC_F + MC_I}{2} \]

We can then plug this \( P^*_I \) into D1 & D2’s best response functions

\[ q_1 = \frac{a - (\frac{a - MC_F + MC_I}{2}) - MC_F}{3b} \]

\[ q_1 = \frac{a - MC_F - MC_I}{6b} = q_2 \] by symmetry

We know \( P_F = a - bQ \)

Therefore,

\[ P_F = a - \frac{a - MC_F - MC_I}{3} \]
\[ P_F = \frac{2a + MC_F + MC_I}{3} \]

We can now analyze profits under the base case

\[ \pi_{U_i} = (P_I - MC_I)(Q) \]

\[ \pi_{U_i} = \left(\frac{a - MC_F - MC_I}{2}\right)\left(\frac{a - MC_F - MC_I}{3b}\right) \]

\[ \pi_{U_i} = \frac{(a - MC_F - MC_I)^2}{6b} \]

\[ \pi_{D_{i,2}} = (P_F - P_I^* - MC_F)q_{i,2} \]

\[ \pi_{D_{i,2}} = \left(\frac{2a + MC_F + MC_I}{3}\right)\left(\frac{a - MC_F + MC_I}{2}\right)\left(\frac{a - MC_I - MC_F}{6b}\right) \]

\[ \pi_{D_{i,2}} = \frac{(a - MC_I - MC_F)^2}{6b} \]

\[ \pi_{D_{i,2}} = \frac{(a - MC_I - MC_F)^2}{36b} \]

**Merger between U1 & D1 – No Legislation**

Without legislation, upon integration V1 will choose to not sell to D2 and instead will create a vertically integrated monopoly and D2 will be forced out of the market since it can no longer obtain the input needed. This is an important implication of some assumptions made in the model and will be prevalent throughout the rest of the analysis. The reason why this is the case is described below:
First, if an integrated firm sells one additional unit of the intermediate good, it conjectures that other intermediate good producers maintain their output and a final good producer increases its output by one unit. Second, if a vertically integrated firm buys an extra unit of the intermediate good, it assumes that an intermediate good producer expands its output by one unit and other final good producers maintain their output. Third, \( MC_1 < P_I < P_F - MC_F \). The second inequality means that unintegrated final good producers earn positive profits. Given these three assumptions, a vertically integrated firm chooses not to participate in the market for the intermediate good. (Salinger 347-348)

Since \( P_I > MC_I \) the firm will always produce the input internally. Also, suppose the vertically integrated firm sells \( X \) units of the intermediate good. If the firm were to sell 0 units of the intermediate good instead of \( X \) units and instead produce \( X \) more units of the final good then based on the first assumption the unintegrated final good producers would reduce their output by \( X \) units. Total output and price would therefore remain unchanged. Thus, the change in the vertically integrated firm’s profit would be \( (P_F - P_I - MC_F)X > 0 \) based on the assumption that vertically unintegrated final good producers earn a positive profit. For this reason, it is not profit maximizing for the vertically integrated producer to sell any units of the intermediate good.

\[
\text{Input Cost} = MC_I \\
\text{Total Cost} = MC_I + MC_F
\]

This is now a simple maximization problem

\[
\pi_V = (P_F - MC_F - MC_F)Q_V
\]
\[ \pi_{V_1} = (a - bQ_v - MC_I - MC_F)Q_v \]

\[ \frac{d\pi_{V_1}}{dQ_v} = a - 2bQ_v - MC_I - MC_F = 0 \]

\[ Q_v = \frac{a - MC_I - MC_F}{2b} \]

\[ P_{F_v}^* = a - b\left(\frac{a - MC_I - MC_F}{2b}\right) \]

\[ P_{F_v}^* = a + \frac{MC_I + MC_F}{2} \]

\[ \pi_{V_1} = (P_{F_v}^* - MC_I - MC_F)Q_v \]

\[ \pi_{V_1} = \left(\frac{a + MC_I + MC_F}{2} - MC_I - MC_F\right)\left(\frac{a - MC_I - MC_F}{2b}\right) \]

\[ \pi_{V_1} = \frac{(a - MC_I - MC_F)^2}{4b} \]

**Merger between U1 & D1 + FCC Restrictions**

Upon merging, the FCC implemented a baseball style arbitration process to ensure that despite the merger, NBC continued to offer their content to all downstream content distributors at fair market value. For our purposes, this mechanism is essentially equivalent to requiring the vertically integrated firm to continue to offer the input at the pre-merger price following the merger of U1 & D1. If the price before the merger was the
competitive price, then forcing the upstream firm to continue to offer the input at this price accomplishes the aim of the baseball style arbitration mechanism.

Stage 1: V1 announces $P_{i}^{FCC} = P_{i}^{*}$ from base case

Stage 2: V1 & D2 determine $Q_1$ and $Q_2$

$$P_F = a - b(q_1 + q_2)$$

$$P_i^* = \frac{a - MC_F + MC_I}{2}$$

We can use $P_i^*$ to determine D2’s best response as a function of $q_1$

$$\pi_{D_2} = (P_F - P_i^* - MC_F)q_2$$

$$\pi_{D_2} = (a - b(q_1 + q_2) - \frac{a - MC_F + MC_I}{2} - MC_F)q_2$$

$$\pi_{D_2} = \left(\frac{a - MC_F - MC_I}{2} - b(q_1 + q_2)\right)q_2$$

$$\frac{d\pi_{D_2}}{dq_2} = \frac{a - MC_F - MC_I}{2} - bq_1 - 2bq_2 = 0$$

$$q_2 = \frac{a - MC_F - MC_I}{4b} - \frac{q_1}{2}$$

$$\pi_{V_1} = (P_F - MC_I - MC_F)q_1$$

$$\pi_{V_1} = (a - b(q_1 + q_2) - MC_I - MC_F)q_1$$

$$\frac{d\pi_{V_1}}{dq_1} = a - 2bq_1 - q_2 - MC_I - MC_F = 0$$

$$q_1 = \frac{a - MC_I - MC_F}{2b} - \frac{q_2}{2}$$

We can now plug in one of these equations for $q_1$ and $q_2$ to solve in terms of the independent variables.
\[
q_1 = \frac{a - MC_I - MC_F}{2b} - \frac{a - MC_F - MC_I - q_1}{4b} - \frac{2}{2} \\
q_1 = \frac{a - MC_I - MC_F}{2b} - \frac{a - MC_F - MC_I - q_1}{8b} - \frac{4}{4} \\
\frac{3q_1}{4} = \frac{3(a - MC_I - MC_F)}{8b} \\
q_1 = \frac{a - MC_I - MC_F}{2b} \\
\]
\[
q_2 = \frac{a - MC_F - MC_I}{4b} - \frac{a - MC_F - MC_I}{2b} - \frac{2}{2} \\
q_2 = \frac{a - MC_F - MC_I}{4b} \\
\]

Note: This is only possible if \(q_2 = 0\)

Essentially, even though V1 is required to offer the input at \(P_1^*\), the integrated firm’s input cost is sufficiently lower than \(P_1^*\) that they can compete the price of the final good low enough that D2 would operate at a loss if they chose participate. Not only can V1 perform this action, but our maximization solution also implies that it is in V1’s interest to do so (and D2 knows this). V1 will simply announce \(q_1\) such that \(P_F - P_1^* - MC_F = 0\).

Notably, this optimal \(q_1\) is actually equal to the quantity chosen by the vertically integrated pure monopolist in the previous model.

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So what if there are more than 2 downstream firms? Let us assume there are \(n\) downstream firms (D1, …, Dn) and still just one upstream firm U1.

We solve like we did earlier:
\[ \pi_{D1} = (a - b(q_1 + ... + q_n) - P_I - MC_F)q_i \]

\[ \frac{d\pi_{D1}}{dq_1} = a - 2bq_1 - b(q_2 + ... + q_n) - P_I - MC_F = 0 \]

\[ q_1 = \frac{a - P_I - MC_F}{2b} - \frac{(q_2 + ... + q_n)}{2} \]

\[ q_1 = q_2 = ... = q_n \text{ by symmetry} \]

\[ q_i = \frac{a - P_I - MC_F}{2b} - \frac{(n-1)q_i}{2} \]

\[ q_i = \frac{a - P_I^* - MC_F}{(n+1)b} \text{ for } i \in (1, \ldots, n) \]

U1 then solves the maximization problem:

\[ \pi_{U1} = (a - b\frac{n(a - P_I - MC_F)}{(n+1)b} - MC_I)(\frac{n(a - P_I - MC_F)}{(n+1)b}) \]

\[ \pi_{U1} = (P_I - MC_I)(\frac{n(a - P_I - MC_F)}{(n+1)b}) \]

\[ \frac{d\pi_{U1}}{dP_I} = \frac{n(2P_I^* - MC_F + MC_I)}{(n+1)b} = 0 \]

\[ P_I^* = \frac{a - MC_F + MC_I}{2} \]

As we see here, \( P_I^* \) does not depend on \( n \) and therefore increasing the number of downstream firms has no effect on the price which the integrated V1 is required to offer the input at following the merger. For this reason, the upstream firm can simply merge with any one of the downstream firms, take advantage of the elimination of double marginalization and offer the quantity at which all other downstream firms would operate at a loss based on their input costs \( (P_I^*) \). This finding is a result of the overwhelming market power U1 possesses in this game. Since there is only 1 upstream firm, U1 is able
to act as a monopolist and charges the monopoly input price regardless of the number of downstream firms. Upon merging with any one of the downstream firms the FCC regulations only require the vertically integrated entity to continue to offer the input at this monopoly price. At the same time, the vertically integrated firm now benefits from the elimination of double marginalization and is able to compete away all other firms simply by offering the optimal monopoly quantity of the final good.

The next logical question is: What if we increase the number of upstream firms to more than 1? By increasing the number of upstream firms we can begin to analyze the effects of the FCC legislation in markets that are more competitive than that considered above. Unlike increasing the number of downstream firms, this has a much more dramatic effect on the outcome of the game.

First of all, if we continue to assume Bertrand competition in the upstream division with homogenous products the upstream firms compete the input price (P_I) down to cost. This is because with Bertrand competition if U1 were to offer a price greater than MC_1, U2 could offer to sell the good at just an epsilon less than the price U1 announced he would capture the entire market and earn a profit. For this reason, U1 & U2 would compete the price all of the way down to MC_1, at which point each would earn a profit = 0 and the price could not rationally be competed any lower. Ordover, Salop & Saloner analyze the effects of a merger in this type of game but the FCC regulations would change the results quite a bit. Since the new entity, V1, would be required to continue to
offer the input at the pre-merger competitive price (where \( P_i = MC_i \)) the non-merged D2 would continue to be able to purchase the input at cost and since no margins would be earned in the upstream phase there is no benefit of reduced double marginalization or foreclosure for U1 & D1. Therefore, there is no incentive for U1 & D1 to merge. As a result, the threat of the FCC regulations in this game would prevent a merger from ever occurring.

To keep things interesting, we shall now assume Cournot competition in the upstream phase. This presents a small issue when it comes to the actual implementation of the FCC regulations. Since the FCC regulations essentially impose a maximum price for the input it is somewhat awkward to implement this regulation in the context of Cournot (quantity) competition. However, we can simply interpret the regulations as a minimum quantity requirement in the upstream input market such that the input price remains equal to or less than the pre-merger input price. The question then is, in the event the optimal input quantity is below the minimum required who should be mandated to supply the additional units? Since the upstream firms earn positive profits in this game (even when forced to charge the pre-merger price) the conservative assumption is simply that the non-merged upstream firms must supply the additional units. This is a conservative assumption because if the merged entity supplied those additional units their profit would be higher than if the non-merged upstream firms supplied the additional units. Since we are considering the motivation for the firms to merge it is better to err on the side of conservatism.
We shall first consider a base case in which no merger takes place with 2 upstream firms and 2 downstream firms:

Note: \( q_1 \) & \( q_2 \) are the quantities produced by D1 & D2, respectively. \( q_{i1} \) & \( q_{i2} \) are the quantities produced by U1 & U2, respectively.

\[
\pi_{D_i} = (a - b(q_1 + q_2) - MC_F - P_F)q_i
\]

\[
\frac{d\pi_{D1}}{dq_1} = a - 2bq_1 - bq_2 - MC_F - P_F = 0
\]

\( q_1 = q_2 \) by symmetry

\[
q_1 = q_2 = \frac{a - P_F - MC_F}{3b}
\]

We know that \( q_{i1} + q_{i2} = q_1 + q_2 \)

Therefore, \( q_{i1} + q_{i2} = \frac{2(a - P_F - MC_F)}{3b} \)

Rearranging we can obtain the inverse demand function

\[
P_I = a - MC_F - \frac{3b(q_{i1} + q_{i2})}{2}
\]

Using this inverse demand we can analyze the upstream firms’ strategic interaction

\[
\pi_{U1} = (P_I - MC_I)q_{i1}
\]

\[
\pi_{U1} = (a - MC_F - \frac{3b(q_{i1} + q_{i2})}{2} - MC_I)q_{i1}
\]

\[
\frac{d\pi_{U1}}{dq_{i1}} = a - MC_F - \frac{3}{2} b(2q_{i1} + q_{i2}) - MC_I
\]

\( q_{i1} = q_{i2} \) by symmetry

Therefore, \( q_{i1} = q_{i2} = \frac{2}{9b}(a - MC_I - MC_F) \)

In this case, \( q_{i1} = q_{i2} = q_1 = q_2 \)
We can see the effects of additional competition in the upstream phase in the Cournot price $P_1$ of the intermediate good. The price is now $\frac{a - MC_I - MC_F}{6}$ less than when there was only one firm upstream. (Note: $a - MC_I - MC_F$ must be positive)

We now calculate the profits of the upstream and downstream divisions to serve as a baseline comparison versus the merged entities profits to determine whether a merger would be profitable.

$$
\pi_{U1} = \frac{2}{9b} (a - MC_I - MC_F)(\frac{a - MC_F + 2MC_I}{3} - MC_I)
$$

$$
\pi_{U1} = \frac{2}{27b} (a - MC_I - MC_F)^2
$$

$$
\pi_{D1} = \frac{2}{9b} (a - MC_I - MC_F)(\frac{5a + 4MC_F + 4MC_I}{9} - \frac{a - MC_F + 2MC_I}{3} - MC_F)
$$

$$
\pi_{D1} = \frac{8}{81b} (a - MC_I - MC_F)^2
$$

$$
\pi_{D1} + \pi_{U1} = \frac{14}{81b} (a - MC_I - MC_F)^2
$$
We shall now consider the case in which U1 and D1 merge. Salinger analyzes this model in his paper *Vertical Mergers and Market Foreclosure*.

\[ \pi_{V1} = (a - b(q_1 + q_2) - MC_I - MC_F)q_1 \]

\[ \frac{d\pi_{V1}}{dq_1} = a - 2bq_1 - bq_2 - MC_I - MC_F = 0 \]

\[ q_1 = \frac{a - MC_I - MC_F - \frac{q_2}{2}}{2b} \]

\[ \pi_{D2} = (a - b(q_1 + q_2) - P_I - MC_F)q_2 \]

\[ \frac{d\pi_{D2}}{dq_2} = a - bq_1 - 2bq_2 - P_I - MC_F \]

\[ q_2 = \frac{a - P_I - MC_F - \frac{q_1}{2}}{2b} \]

Therefore,

\[ q_1 = \frac{a - MC_I - MC_F}{2b} - \frac{a - P_I - MC_F - \frac{q_1}{2}}{2} \]

\[
\begin{align*}
q_1 &= \frac{a - 2MC_I + P_I - MC_F}{3b} \\
q_2 &= \frac{a - 2P_I + MC_I - MC_F}{3b}
\end{align*}
\]

We know \( q_2 = q_{i2} \). Use the solution for \( q_2 \) to find the inverse demand function

\[ P_I = \frac{a + MC_I - MC_F - 3bq_{i2}}{2} \]

\[ \pi_{U2} = (P_I - MC_I)q_{i2} \]

\[ \pi_{U2} = (a + MC_I - MC_F - 3bq_{i2} - MC_I)q_{i2} \]
\[
\frac{d\pi_{i2}}{dq_{i2}} = \frac{a - MC_I - MC_F}{2} - 3bq_{i2} = 0
\]

\[
q_{i2} = \frac{a - MC_I - MC_F}{6b}
\]

\[
P_i = \frac{a + MC_I - MC_F - 3b(a - MC_I - MC_F)}{2}
\]

\[
P_i = \frac{a + 3MC_I - MC_F}{4}
\]

Interestingly, this price is actually lower than the input price from the base case.

Although there is now one less independent supplier, which causes \( P_i \) to increase, the merged firm capitalizes on the elimination of double marginalization and increases total output. As a result, the residual demand curve faced by unintegrated final good producers and therefore their demand for the final good shifts back. This causes a reduction in \( P_i \). In this case, the second effect dominates since \( P_i \) decreases. Since \( P_i \) is lower following the merger than beforehand, the FCC legislation would have no effect here. This is an important result – The FCC legislation does not alter the outcome at all when the double marginalization effect outweighs the foreclosure effect of reducing the number of suppliers.

\[
q_i = \frac{5(a - MC_I - MC_F)}{12b}
\]

\[
Q = \frac{7(a - MC_I - MC_F)}{12b}
\]
\[ P_F = \frac{5a + 7MC_I + 7MC_F}{12} \]

Notably, this final goods price is lower than the base case final goods price by \( \frac{5(a - MC_I - MC_F)}{36} \) which means that consumers are better off after the merger than beforehand.

\[
\pi_{V1} = \left( \frac{5a + 7MC_I + 7MC_F}{12} - MC_I - MC_F \right) \left( \frac{5(a - MC_I - MC_F)}{12b} \right)
\]

\[
\pi_{V1} = \frac{25(a - MC_I - MC_F)}{144b}
\]

\[
25/144 - 14/81 = 1/1296 \rightarrow \text{There is an incentive for the firms to merge.}
\]

The next case we should like to consider is one in which a merger actually causes the intermediate good price to increase. We will work out the general case of this model and then pick a specific case to analyze the effects of the FCC legislation. Interestingly, we can show that the first merger in an industry (ex. 5 upstream and downstream firms, U1 & D1 merge) will never cause the input price to increase since the effect from elimination of double marginalization is most pronounced here. For this reason, we will have to select an example where mergers have already taken place and the FCC legislation becomes effective since an additional merger would increase the price of the intermediate good.

**General Model**

The vertically integrated firms are indexed (1,...,n), unintegrated upstream firms indexed \((n + 1, \ldots, N_U)\), unintegrated downstream firms indexed \((n + 1, \ldots, N_F)\)

\[
\pi_{V1} = (a - b(q_1 + \ldots + q_{N_F} - MC_F - MC_I)q_1
\]

\[
\frac{d\pi_{V1}}{dq_1} = a - 2bq_1 - b(q_2 + \ldots + q_n + q_{n+1} + \ldots + q_{N_F}) - MC_F - MC_I = 0
\]
\( q_i = q_2 = \ldots = q_n \) and \( q_{n+1} = \ldots = q_{NF} \) by symmetry

\[
q_i = \frac{a - MC_I - MC_F}{b(n+1)} - \frac{(N_F - n)q_j}{n+1} \quad \text{for } i \in (1, \ldots, n), \ j \in (n+1, \ldots, N_F)
\]

\[
\pi_{D_{n+1}} = (a - b(q_1 + \ldots + q_{N_F}) - P_I - MC_F)q_{n+1}
\]

\[
\frac{d\pi_{D_{n+1}}}{dq_{n+1}} = a - b(q_1 + \ldots + q_n + 2q_{n+1} + q_{n+2} + \ldots + q_{N_F}) - P_I - MC_F = 0
\]

by symmetry \( \Rightarrow q_j = \frac{a - P_I - MC_F}{(N_F - n + 1)b} - \frac{nq_i}{N_F - n + 1} \)

We can then plug in these derivations for \( q_i \) and \( q_j \) to solve as a function of \( P_I \) and the independent variables

\[
q_i = \frac{1}{b} \left[ \frac{1}{N_F + 1} (a - MC_I - MC_F) + \frac{N_F - n}{N_F + 1} (P_I - MC_I) \right] \quad \text{for } i \in (1, \ldots, n),
\]

\[
q_j = \frac{1}{b} \left[ \frac{1}{N_F + 1} (a - P_I - MC_F) + \frac{n}{N_F + 1} (MC_I - P_I) \right] \quad \text{for } j \in (n + 1, \ldots, N_F)
\]

We can then use this demand function for \( q_i \) to determine the inverse demand function for the intermediate good:

\[
P_I = \frac{a - MC_F + nMC_I}{n+1} - \frac{N_F + 1}{(N_F - n)(n + 1)} bQ_\pi
\]

\[
\pi_{U_{n+1}} = \left( \frac{a - MC_F + nMC_I}{n+1} - \frac{N_F + 1}{(N_F - n)(n + 1)} b(q_{n+1} + \ldots + q_{N_F}) - MC_I \right) q_{n+1}
\]

\[
\frac{d\pi_{U_{n+1}}}{dq_{n+1}} = a - MC_F - MC_I - \frac{N_F + 1}{(N_F - n)(n + 1)} b(2q_{n+1} + q_{n+2} + \ldots + q_{N_F}) = 0
\]

\( q_{n+1} = \ldots = q_{NF} \) by symmetry

\[
q_j = \frac{N_I - n}{(N_F - n + 1)(N_F + 1)b} (a - MC_I - MC_F)
\]
\[ q_i = \frac{1}{b(N_F + 1)}(a - MC_I - MC_F) \left( 1 + \frac{N_F - n}{(N_I - n + 1)(n + 1)} \right) \]

We can now substitute the solution for \( q_i \) in to solve for \( P_I \):

\[ P_I = MC_I + \frac{a - MC_I - MC_F}{(N_I - n + 1)(n + 1)} \]

\[ Q_F = \frac{N_F}{b(N_F + 1)}(a - MC_I - MC_F) \left( 1 - \frac{N_F - n}{(N_I - n + 1)(n + 1)} \right) \]

\[ P_F = MC_I + MC_F + \frac{a - MC_I - MC_F}{N_F + 1} \left( 1 + \frac{N_F - n}{(N_I - n + 1)(n + 1)} \right) \]

Now we have worked out a framework to explore the effects of mergers in a variety of different scenarios – we have solved for a varying number of upstream and downstream firms and a varying number of merged entities within the industry. As promised we will show that the first merger in an industry will never result in an increase in \( P_I \) in this model.

Since \( P_I = MC_I + \frac{a - MC_I - MC_F}{(N_I - n + 1)(n + 1)} \), a merger can only increase \( P_I \) if \((N_I - n + 1)(n + 1)\) decreases. If we assume \( n = 0 \) in the base case then the denominator = \( N_I + 1 \) and then after a merger the denominator = \( 2N_I \). Therefore, for \( P_I \) to increase \( 2N_I < N_I + 1 \) which is only possible if \( N_I < 1 \). As a matter of fact, we can take \[ \frac{dP_I}{dn} = \frac{(2n - N_I)(a - MC_I - MC_F)}{(n + 1)^2(n - N_I - 1)^2} \]

and the sign of this derivative is dependent upon \( 2n - N_I \) which is negative as long as
n < N/2. Therefore, as long as less than half of the intermediate good producers are vertically integrated the input price will always decrease. We could also show that when n < N/2 that the final good price must also always decrease.

One such scenario in which P1 actually increases is with 4 upstream firms, 4 downstream firms and 2 mergers in the base case scenario. In the base case, 
\[ P_i = \frac{a + 8MC_I - MC_F}{9} \]
and following the merger the new price would become 
\[ P_i = \frac{a + 7MC_I - MC_F}{8} \]

We must confirm that this merger is profit maximizing for the two firms involved.

Pre-merger profits:

\[ \pi_{U3} = \frac{2}{135b} (a - MC_I - MC_F)^2 \]
\[ \pi_{D3} = \frac{4}{135b} (a - MC_I - MC_F)^2 \]
\[ \pi_{U3} + \pi_{D3} = \frac{2}{45b} (a - MC_I - MC_F)^2 \]

Post-merger profits (no regulations):

\[ \pi_{V3} = \frac{81}{1600} (a - MC_I - MC_F)^2 \]

For the merger to take place it must be that \( \pi_{U3} + \pi_{D3} \leq \pi_{V3} \)

\[ \pi_{V3} - (\pi_{U3} + \pi_{D3}) = \frac{89}{14400} (a - MC_I - MC_F)^2 \]
Therefore, the merger will take place without FCC regulations.

Using the analysis in the following section we can show that under the FCC regulations the merger would still be profit-maximizing, but the regulations would prevent \( P_f \) from
increasing. The regulation therefore provides for the merger to capture the positive effects of reduced double marginalization while simultaneously preventing the negative effects of foreclosure. For this reason, the merger would not be quite as profitable for the merging entities as a result but consumers would be better off.

So the next step is to implement the FCC legislation into the general model so that we can determine the effects of the legislation on intermediate and final good prices as well as firm profits. An important point to note here is that since the intermediate good price decreases as long as \( n < N_I/2 \) then \( P_I^{FCC} \) = the price at which the FCC legislation begins to take effect which occurs when \( n = N_I/2 \). We can substitute this equality into our solution from the general model for \( P_I \) and we find:

\[
P_I^{FCC} = MC_I + \frac{a - MC_I - MC_F}{\left(\frac{N_I}{2} + 1\right)^2}
\]

We assume this \( P_I^{FCC} \) throughout the solution of this model. For this reason, the solution we find only holds if \( n \geq N_I/2 \) (where the FCC legislation is effective in restricting the intermediate good price from increasing).

\[
\pi_{Dj} = (a - b(q_i + ... + q_n + q_{n+1} + ... + q_j + ... + q_{N_f}) - P_I^{FCC} - MC_F)q_j
\]

\[
\pi_{Dj} = (a - b(q_i + ... + q_n + q_{n+1} + ... + q_j + ... + q_{N_f}) - \left[MC_I + \frac{a - MC_I - MC_F}{\left(\frac{N_I}{2} + 1\right)^2}\right] - MC_F)q_j
\]
\[
\frac{d\pi_{Dj}}{dq_j} = \left(\frac{N_f + 1}{2}\right)^2 \left(\frac{N_f}{2} + 1\right) - b(q_1 + \ldots + q_n) - b(q_{n+1} + \ldots + 2q_j + \ldots + q_{N_f}) = 0
\]

We know \(q_1 = \ldots = q_n\) and \(q_{n+1} = \ldots = q_j = \ldots = q_{N_f}\)

Therefore,

\[
q_j = \left(\frac{N_f + 1}{2}\right)^2 \left(\frac{N_f}{2} + 1\right) - nq_i \quad \frac{nq_i}{N_f - n + 1}
\]

\[
\pi_{v1} = (a - b(q_1 + \ldots + q_n + q_{n+1} + \ldots + q_{N_f}) - MC_I - MC_F)q_1
\]

\[
\frac{d\pi_{v1}}{dq_1} = a - b(2q_1 + \ldots + q_n) - b(q_{n+1} + \ldots + q_{N_f}) - MC_I - MC_F = 0
\]

\[
q_1 = \frac{a - MC_I - MC_F}{(n+1)b} - \frac{(N_f - n)q_j}{n + 1}
\]

Substituting in the solution for \(q_i\) into \(q_j\) we get:

\[
q_j = \left(\frac{N_f + 1}{2}\right)^2 \left(\frac{N_f}{2} + 1\right) - (n+1) \quad (a - MC_I - MC_F)
\]

\[
q_i = \frac{(a - MC_I - MC_F)}{(n+1)b} \left[ 1 - \frac{(N_f - n)\left(\frac{N_f + 1}{2}\right)^2 - (n+1)}{\left(\frac{N_f}{2} + 1\right)^2 (N_f + 1)} \right]
\]
We can analyze the effects of the number of mergers on $P_F$ by differentiating with respect to $n$.

$$\frac{dP_F}{dn} = -\frac{1}{\left(\frac{N_F}{2}+1\right)^2 (N_F+1)b} (a - MC_I - MC_F)$$

As we see here, $P_F$ is always decreasing in $n$. While in Salinger’s model he shows that $P_F$ may increase due to the effect of foreclosure resulting from a merger, the FCC price restriction on $P_I$ effectively prevents this from occurring. This is an attractive result for the FCC mechanism since it does not restrict the benefits of reduced double marginalization but is highly effective in preventing foreclosure of unintegrated downstream firms. However, this must be taken with a grain of salt since the model being considered has fairly specific assumptions (linear demand, Cournot competition, homogenous products, etc.) so these results do not necessarily extend to industries with different dynamics.
Conclusion & Extension

We have found many interesting results regarding the effects of the FCC restrictions on post-merger intermediate goods prices in the context of linear demand and homogenous goods. With just one upstream firm the restriction is completely ineffective. The upstream producer’s overwhelming market power pre-merger coupled with the eliminated double marginalization allows the vertically integrated entity to produce the monopoly quantity of the final good and the unintegrated downstream firm still cannot compete even with pre-merger intermediate goods pricing. When we extend the model we find that under the specific assumptions of this model the final good price is actually always decreasing in the number of mergers with the FCC legislation in place. This is an attractive result since consumers are always better off as the industry consolidates. This result is not true without the FCC legislation in place since the negative effects of foreclosure of unintegrated downstream firms may overwhelm the positive effects of reduced double marginalization. Interestingly, there may be situations in which a firm would like to merge without the FCC legislation but would not like to if the legislation were enacted. This could occur if the economic incentive behind the merger stems from foreclosing unintegrated final good producers (which the FCC legislation prevents).

The television industry is entering a new era of dramatic change due to technological innovation and it seems as if consolidation could be a forthcoming trend. The FCC has taken what this model suggests to be sufficient steps to protect consumers and hopefully the changes will continue to yield content people enjoy at reasonable costs. Interestingly, new content providers that distribute their content directly to consumers over the Internet (new proprietary YouTube channels for example) could be fairly
comparable to vertically integrated content creation and distribution firms. It will be interesting to see how the FCC will treat these new content creators.

Future research regarding this topic could explore a variety of different paths. First of all, the same model could be considered with non-linear demand. Removing the bounds of linear demand would help broaden the scope of the results but may also result in more indeterminate conditions. Another very interesting model to examine would be one in which the upstream and downstream firms produce differentiated products. This would be much more comparable to the actual television content creation and distribution industry. This model could analyze Bertrand competition in either phase without the somewhat arbitrary outcomes Bertrand games result in when dealing with homogenous goods. However, the math involved with a model utilizing differentiated products would be much more difficult than that presented in this paper and the resulting conditions may be more difficult to interpret. One could also incorporate the work of Bonnanno & Vickers to describe and analyze the manager/owner relationships inherent in the vertically integrated firms.
References


