2010 FCC Media Ownership Study X:

Broadcast Ownership Rules and Innovation

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Abstract

Innovation is a critical component of sustained economic growth, so the effect of government regulation on the initiation and implementation of innovation is a key measure of its effectiveness and appropriateness. This paper examines the effect of the Federal Communications Commission's broadcast ownership regulations on the implementation of a relatively recent innovation, multicasting of broadcast television signals, and on the intensity with which broadcasters use the spectrum available to them. I study the factors influencing market-level multicasting and find that Federal Communications Commission (FCC) broadcast ownership regulations have little to no effect on the spread of this innovation, although one regression may indicate that the existing regulations support increased intensity of innovation. Rather, the implementation of this innovation is driven by the number of stations, particularly the number of commercial television stations and PBS stations, and is affected to some extent by the size of the market and competition from multichannel video providers.

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I. Introduction

The purpose of this study is to examine the general relationship between broadcast ownership regulations and the use of an available innovation. Specifically, I investigate the relationship between market-based broadcast ownership regulations and the prevalence of a relatively new use of spectrum, multicasting television broadcast signals. To the extent that multicasting represents the tendency to employ innovation, this study will indicate the positive or negative effect FCC broadcast regulations have on innovation, and thus whether regulation represents a cost or benefit in this dimension.

Innovation is a key factor, perhaps the key factor, in determining the long-term potential for economic growth. Technological progress allows greater production with the same amount of resources, and thus supports long-run economic well-being. If, therefore, a particular regulation encourages or hinders the use of available innovations, that regulation could potentially represent a great benefit or detriment to economic growth and activity. Most generally, institutions and incentives that prevent economic agents from employing and profiting from innovations can retard the long-run potential for growth [Grossman and Helpman (1993)].

The development of broadcasting technology generally represents one of the greatest innovations of the end of the 19th century and of the entire 20th century, and the development of television broadcasting represents one of the greatest innovations of the 20th century. The spread and use of these innovations was almost always governed and controlled by government regulation, as detailed below, and this influence continues today. In the present context, television broadcasters were required by government policy to move to digital transmission technologies during the first decade of the 21st

century, which allowed broadcast of high definition content over the digital frequencies. The government also gave to broadcasters sufficient bandwidth for additional standard definition transmissions over which broadcasters could show entirely separate streams of content. Thus, how television broadcasters responded to these changes represented the opportunity to innovate in the services they provided to consumers.

I note here that this study does not directly measure the propensity to develop new innovations; indeed, the regulatory environment limited the potential uses for television broadcaster spectrum. Instead, I look at the propensity to employ an available innovation that has already been developed. This latter propensity is still an important one: any market in which new services are possible but are not deployed is a sclerotic one indeed. Moreover, every innovation is developed by one or by a few and then propagates to consumers through markets in a variety of ways. If broadcast ownership regulations supported, or at least did not impede, the spread of an available innovation, then they are at least not harmful to consumers in relation to innovation. If, on the other hand, the regulations discouraged the use of an available innovation, the future effect of these regulations on innovation should be part of any proceeding to alter them.

The paper proceeds as follows. In the next section, I review the background of this issue, related literature, and relevant theory. In Section III, I develop a theoretical model to explain the decision to deploy multicasting technology. In Section IV, I discuss the data I employ to study this issue. In Section V, I demonstrate the empirical equations I estimate to study the relationship between regulation and innovation, and I discuss the results from estimating those equations. Finally, the last section summarizes and concludes.

II. Background, Innovation Theory, and Literature Review

This study touches on a number of topics with which most people are familiar, but topics that many may not consider in great detail because those topics are so ingrained in everyday life. Therefore, I review here these subjects in sufficient detail so that an interested reader has sufficient context to judge the empirical work I present subsequently. With this in mind, I first turn to a short history of broadcasting in the U.S., and the regulation of broadcast ownership, particularly ownership of television broadcasting.

A. Broadcasting History and Regulation

Radio broadcasting technology was developed in the late 19th century, although it was initially viewed as a point to point communication system.[1] Its use as a broadcast technology was undiscovered until 1916. The U.S. government, particularly the Navy, used its influence to assure that the U.S. radio interests of the British Marconi Telegraph Company found their way into the hands of General Electric. General Electric formed the Radio Corporation of America (RCA) to pursue broadcast radio, and RCA later merged into the National Broadcasting Company, later universally known as NBC.[2] The first radio station debuted in Pittsburgh in 1920.

The idea of television technology was first proposed in the late 19th century also, but implementation of television technology began in earnest in the early 20th century. Practical implementation of the technology, first a mechanical technology involving

[1] The history of broadcasting contained in the next few paragraphs is recounted in many places, such as [Coase (1959)] and [Huber et al. (1999)].
[2] Of course, NBC more recently became NBCUniversal and is now majority-owned and operated by Comcast Corporation.

spinning disks, arose in the first two decades of the 20th century, although a device capable of transmitting frames fast enough to transmit moving pictures was not demonstrated until 1926. By this time, inventors were working on electronic transmission technologies, which quickly demonstrated themselves as more reliable and capable of far higher resolution, and thus electronic television displaced mechanical versions.

A few experimental, and very low resolution, broadcasts began in the early 1930's, but watchable broadcasts began after the creation of the FCC by the Communications Act of 1934. The FCC issued experimental licenses through the late 1930's, and even in the early 1940's, but only 5,000 televisions were in operation to receive them. World War 2 interrupted the production of civilian broadcast receiving equipment, but 1946 saw the beginning of regular network broadcasts, and nationwide coverage was achieved by 1951. Color television broadcasts began soon after but did not completely displace black and white for decades.

Thus, government regulation of broadcasting transmissions began not long after the rise of radio broadcasts, and covered virtually the entire history of television broadcasts. One aspect of these regulations concerns limits on broadcast ownership, and on cross-ownership with other media, such as newspapers. As early as 1938, the FCC was using ownership concentration as a criterion in granting broadcast licenses, using a presumption against what have become called, imprecisely, as ownership "duopolies," meaning in that context ownership by the same entity of two or more radio stations in the same band [Candeub (2008)]. Over time, these regulations have developed, and waxed and waned, with the addition of cross-ownership regulations, and a substantial loosening of the regulations in the Telecommunications Act of 1996.

In their current form, broadcast ownership regulations generally take the following form:

- A single entity may not own television stations that reach collectively more than 39 percent of U.S. television households.
- The dual network rule permits common ownership of multiple broadcast networks but prohibits a merger between the "Big 4" networks (ABC, CBS, Fox, and NBC).
- A single entity may own up to two television stations in the same television market if either: (1) the service areas do not overlap; or (2) at least one of the stations is not ranked among the top four stations in the television market and at least eight independently-owned television stations remain in the market.
- Cross-ownership of daily newspapers and broadcast stations (either television or radio) in the same market is governed by a case-by-case approach, but general a combination of a newspaper and a single broadcast station in the top 20 television markets is presumed to be in the public interest, and combinations in smaller markets are presumed not to be in the public interest. For television-newspaper cross-ownership, a presumption in favor of a merger in the top 20 television markets requires that the television station is not ranked among the top four stations in the television market and at least eight independently-owned "major media voices" (major newspapers and full power television stations) will remain in the market post-merger.
- Cross ownership between radio and television stations in the same television market, and ownership limits on the number of radio stations in a local radio market, are allowed based on sliding scales depending on the size of the markets.[3]

These ownership limits are part of longstanding FCC policy and represent part of its attempt to interpret what is called the FCC's "public interest mandate," which springs from the requirement of the Communications Act of 1934 to issue and renew broadcast licenses in accordance with the "public interest, convenience, or necessity."[4] The FCC has implemented ownership regulation with the sometimes conflicting goals of

[3] Readers interested in more detailed accounting of the FCC's media ownership rules can consult a number of sources, including the *Notice of Inquiry*, 25 FCC Rcd 6086, 75 FR 33227 (2010), ¶¶ 17-27.

[4] 47 U.S.C. § 301.

competition, localism, and diversity. The public interest mandate, and the FCC's implementation of it through broadcast ownership regulations, has been the subject of continuing controversy, in the courts, Congress, and elsewhere,[5] and the FCC is currently required to review its broadcast ownership regulations every four years.[6] This study represents part of the current review process.

A recent development in the provision of broadcast television is the transition to digital transmission. Congress loaned each broadcast television station spectrum for an additional television broadcast in 1996 and required each station to simulcast. Between 1996 and 2009, full power television stations went through a transition in which they moved from transmitting in analog format to transmitting in digital. Congress set a deadline for June 12, 2009 for all full power television stations to end analog transmissions and thus since June 13, 2009 all full power television stations have been broadcasting in digital format.[7]

This transition to digital transmission offers a number of benefits and the opportunity for innovation, the subject of this study. The benefits include higher quality picture and sound including the possibility of high definition broadcasting. The innovation springs from the fact that digital transmission uses spectrum more efficiently so that over the same amount of spectrum broadcasters can transmit a high definition broadcast and multiple standard definition broadcasts, the later known as "multicasting."[8]

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[5] Again, see the *Notice of Inquiry*, 25 FCC Rcd 6086, 75 FR 33227 (2010).
[6] *Telecommunications Act of 1996*, Pub. L. No. 104-104, § 202(h), 110 Stat. 56, 111-12 (1996); *Consolidated Appropriations Act of 2004*, Pub. L. No. 108-199, § 629, 118 Stat. 3 (2004) (amending Sections 202(c) and 202(h) of the 1996 Act).
[7] 47 U.S.C. § 309(j)(14)(A)-(B).
[8] In fact, a broadcaster could send two high definition signals over the spectrum, but neither high definition signal could contain a large amount of movement, as would be found in the transmission of a sporting event. Instances of broadcasting more than one high definition signal simultaneously are rare or nonexistent. Broadcasters are limited in the amount of multicasting by their assigned spectrum and, of

Multicasting is an innovation because previously all broadcasters offered essentially the same product: a single stream of up to 24 hours per day of programming. Now, broadcasters could vary the content, the quality of the content, and the amount of content they provided to consumers.

I now turn to a brief discussion of the nature and benefits of innovation, and how innovation has been viewed over time.

B. Innovation Theory

The term "innovation" can mean many things. A general, popular understanding of innovation is that of "invention," or the introduction of a new product that either does something entirely new or does something in a better way than before. Economists, specifically development economists, frequently use the term "innovation" as a catch-all term to encompass the causes of economic growth not covered by human labor or capital. Critically, empirical work over decades has shown that this innovation component is by far the most important factor in long-term economic growth, particularly in developed economies such as the United States (see, e.g., [Solow (1956)], [Solow (1957)], [Denison (1962)], and [Barro and Sala-i-Martin (1995)]), and thus the most important factor in determining the long-term change in economic well-being. As Nobel Laureate Robert Lucas once wrote, "The consequences for human welfare involved in questions like these [those surrounding long-term economic growth] are simply staggering: Once one starts to think about them, it is hard to think about anything else [Lucas (1988)]."

The earliest consideration of innovation, by Rene Descartes and Adam Smith, among others, considered it a process exogenous to economic growth. In general, these

course, the demand for multicast content. Compression technology continues to improve to allow more multicasting and higher quality multicasting over the same spectrum.

thinkers saw innovation as an action performed by learned individuals outside the economic process, albeit frequently motivated by the hope for individual gain beyond the noble quest for knowledge.[9] Classical economists generally saw the economy as growing due to the process of capital accumulation, thus greatly underplaying the role of technology in supporting the potential for continuing economic growth and leading to dark views of long-run outcomes made most famous by Thomas Malthus.

The late 19th and early 20th century saw the emergence of the practice of large corporations such as Eastman Kodak and AT&T creating laboratories for the purpose of investing directly in basic science research. This is perhaps the origin of industrial entrepreneurship in the quest for growth from innovation. Economic thought took many decades to catch up to the idea of endogenous innovation, or even of the central role of innovation in growth. Some studies are noted above, and other important thinkers in this vein include Joseph Schumpeter, who championed the importance of large company investment in innovation, which he argued supported lowered concern about market concentration or even monopoly since the gain from innovation may greatly outweigh any loss from monopoly behavior ([Schumpeter (1961)], [Schumpeter (1964)], and [Schumpeter (1975)]). Schumpeter therefore is probably the father of the study of the connection between market structure and innovation, which is the broad subject of this paper. More recently, scholars have developed coherent theories modeling innovation as an endogenous economic process undertaken by rational, forward-looking, and profit-seeking agents, such as in [Grossman and Helpman (1993)].

9 See [Kamien and Schwartz (1982)] for a detailed history of the history of innovation. Much of this discussion is taken from that book.

So, current economic thinking supports innovation as an endogenous process in the quest for profits. Current economic thinking also supports a key role for innovation in long-term economic welfare. The earliest linkage between market structure and innovation argued in favor of more concentrated market structures to support innovation because of the overwhelming benefits of innovation in the long run. I now turn to a sampling of literature concerning innovation in general and concerning the link between innovation and market structure in particular, in order to provide a context for the contribution of this paper.

C. Literature Review

Given the discussion of the importance of innovation above, it is not surprising that a voluminous literature has developed, particularly in the second half of the 20th century, and over the past few years. I do not seek to present comprehensive review of this literature here, but instead I present a selection of mostly recent papers that bear some resemblance to the subject I study. By doing so, I create a context within which this paper exists and for its original contribution.

The literature I review here divides roughly into three groups. The first group of papers studies the general relationship between innovation (or product quality) and various characteristics of markets or market structure, but does not directly study media or broadcast markets. The second group studies aspects of market structure and media or broadcast markets. The third group examines the relationship between government policy and innovation, sometimes with the aim of recommending policy changes to foster innovation. In some ways this study bridges across these categories, but it is more of a case study of the effect of the market structure in the television industry that has developed in the presence of government regulation and the effect of that market structure on innovation.

In the first group, one body of literature followed Schumpeter and examined whether market concentration can sometimes be explained by innovation in the quest for a competitive advantage. [Boone (2001)] found that increasing concentration or dominance in an industry may not signal a lack of competition, but instead the market leader innovating to maintain or increase its position. Similarly, [Blundell et al. (1999)] found evidence consistent with high market share firms innovating preemptively. [Levin et al. (1985)], however, suggested in a preliminary analysis that this relationship may be overly simplistic, and that models should take into account technological opportunities and whether innovation can be appropriated. [Boone (2000)] also found that the effect of competitive pressure on a firm's innovation depends upon the firm's position in the market,[10] and that there is a tradeoff between product and process innovation at the industry level (see also [Kretschmer et al. (2009)]). [Carlin et al. (2004)] found that true monopolies innovate less, but also find some evidence that having a few rivals is more conductive to innovation than having many rivals.

[Berry and Waldfogel (2010)] studied product quality and market size, studying in particular the restaurant industry and newspaper industry. They found that for both industries, product quality increases with increasing market size but that larger newspaper markets do not offer much additional variety as they grow large. In concentrated markets, [Mazzeo (2002)] found that firms have strong incentive to differentiate in terms

[10] [Hashmi and Van Biesebroeck (2010)] found a similar relationship, among other things, for the automobile industry. I had hoped to adapt the dynamic industry framework used by Hashmi and Van Biesebroeck (who follow [Ericson and Pakes (1995)]), but it proved intractable given the nature of the broadcast industry and the data available to me. I believe my simplified model is in the same spirit of relating innovation to market structure, but over a shorter time horizon.

of quality in response to potential competition, although this propensity can be overwhelmed in some cases by demand characteristics. As my model predicts, firms are affected by the quality choices of other firms.

In a purely theoretical paper, [Vives (2008)] developed a model to study the relationship between innovation and competitive pressure. In the area of product innovation, Vives predicted that increasing market size has an ambiguous effect on product variety, but that a lower cost of entry unambiguously increases product variety. Vives found generally that competition can drive innovation of various kinds, depending on the definition of innovation. [Park (2009)] examined means of measuring the presence of market power in markets characterized by research and development competition for the market, that is, markets for which innovation plays a critical role. Park reported that participants in such markets will be unable to abuse a dominant position as long as there are no barriers to research and development competition.[11]

[Samaniego (2009)] looked at a situation somewhat similar to the transition of broadcasters to digital, which is the diffusion of costly new technology of production. He noticed that industries with high rates of industry specific technical change experience spikes in investment surrounding new means of production, and that rates of entry and exit are positively related to these changes. Due to the licensing process, the broadcasting industry does not have free entry and exit, but there were a few stations that went dark rather than complete the digital transition, presumably due to the cost of transition.

[11] [Westbrock (2010)] investigated the effect of research and development collaboration among firms, and showed that it leads to concentration but that the concentration is socially optimal when the costs of such activities are significant.

A variety of working papers also address the relationship between innovation and market structure. [Guadalupe et al. (2010)] found a positive relationship between multinational ownership, productivity, and subsequent product and process innovation. [Wang and Shin (2010)] examined the impact of competition on innovation in a supply chain and find that the outcome depends upon whether competition and/or control affect the upstream or downstream portions of the supply chain. [Siebert and Zulehner (2008)], in a study explicitly concerning the relationship between innovation and market structure, were able to explain changes in the market structure of the dynamic random access memory industry through the interdependence of market demand, the pace of innovation, and sunk costs.[12]

The second, much smaller, group of studies examines the relationship between market structure and various portions of the media industry. [George (2007)] found that increasing concentration in the newspaper industry increased both differentiation and variety over a range of topics, and that concentration did not decrease readership. [Fan (2010)] generally found welfare losses from consolidation in local newspaper markets, but that these losses can be mitigated if at least one competitor remains in the market after consolidation. Finally, [Berry and Waldfogel (2001)] showed that consolidation in the radio industry after the Telecommunications Act of 1996 reduced station entry but increased product variety, and demonstrated some evidence that increased concentration increases variety absolutely.

The final group of studies examines the effect of policies on innovation. [Litan (2011)] and [Atkinson et al. (2010)] provided recommendations for legal and policy

[12] For additional studies on the effect of innovation in various sectors of the information technology industry, see [Arora et al. (2010)], [Goettler and Gordon (2009)], and [Eizenberg (2009)].

changes that could foster innovation at low or no cost. [Griliches (1990)] found that patent activity can provide a data source for examining "inventiveness" or innovation across firms and perhaps even at the industry or economy level, even though there are important limitations on its precision. Finally, [Koo and Wright (2010)] showed that patent policy should recognize that patent exclusivity can lower welfare when innovations are sequential.

This paper contributes to understanding in several ways. First, I examine the effect of government regulation, namely structural, ownership, and licensing requirements, on broadcasters as they face choices of whether to innovate, and how. Second, I add to the rather small literature on the relationship between market structure and performance in the media industry. Third, I bridge the gap between the literature on innovation, government regulation, and market structure. I now turn to a theoretical model to provide a framework for the empirical work that follows.

III. Theoretical Framework

In order to examine whether and how broadcasters implement multicasting, I develop here a simple theoretical model. This model will create a framework for the discussion that follows by illustrating the factors that should, in theory, influence a broadcaster's decision to provide multicast channels, and the decision of how many channels and of what quality. I developed the empirical model that follows with this framework in mind, and the empirical model tests the implications of the theoretical model.

Consider first the profit function of any broadcaster:

$$\prod_S = \pi(A_S) - C(Q_S) - F \qquad (1)$$

Profits are a function of advertising (A_S), minus variable costs, which are a function of the quality of programming offered (Q_S), and fixed costs (F). Advertising in turn depends upon the population of the community (P), Q_S, the number of alternative advertising outlets in the market (T, a function of P), and the quality of rival competitors in the market (Q_R)[13] according to:

$$A_S = a(P, Q_S, T(P)) \text{ and} \quad (2)$$

$$Q_S = q(P, Q_R) \quad (3)$$

Thus, the broadcaster selects a profit maximizing level of quality such that:

$$\partial \Pi_S / \partial Q_S = \left(\partial \Pi_S / \partial A_S \; \partial A_S / \partial Q_S \right) + \left(\partial A_S / \partial Q_S \; \partial Q_S / \partial Q_R \right) - \partial C_S / \partial Q_S = 0 \text{ at } Q_S^* \quad (4)$$

The following implicit function for quality results:

$$Q_S^* = q(P, Q_R, T(P)) \quad (5)$$

As does the following implicit function for profits:

$$\Pi_S^* = \pi(a(P, q(P, Q_R, T(P))), T(P)) \quad (6)$$

Thus, the quality chosen by a broadcaster will be at the point at which the marginal cost of adding quality equals the marginal revenue of doing so, and will depend on the population of the community, the quality chosen by rivals, and on the structure of the market for advertising. I expect that the quality chosen by a broadcaster will increase as population increases. It is less clear what will happen as the quality of rivals increases; some broadcasters may choose to race for the top in a competition on quality, while

[13] In all formulas, the quality of the broadcaster making these decisions is subscripted by "S" (for self) and the quality of all other offerings is subscripted by "R" (for rivals). Note that rivals can take a variety of forms, as in the case of the modern competitive marketplace facing broadcasters: other broadcasters, cable and satellite providers, even Internet content that can substitute for broadcast content. This also holds for T, in that advertising is sold on rival broadcasters, cable channels, radio stations, and through a variety of other media. Of course, some of these venues are closer substitutes for local television advertising than others, and I assume that other local broadcasters are the closest possible substitute.

others may choose to offer low quality broadcasting that sells low cost advertising. Quality choices can take a variety of forms, but some examples include the quality and amount of high definition content, broadcasting local news programs in high definition, and the acquisition of a helicopter for news operations. The same is true as T(P) increases: as the market for advertising becomes more crowded, some broadcasters may choose to produce a high quality, high cost venue for advertising, while others may choose to low quality, low cost options, or something in between. T(P) can also encompass, and become even more complicated, other market structure characteristics, such as cable system characteristics, which may include a mix of local, regional, and national cable channels, and which may both compete with and distribute broadcasters.

The decision facing the broadcaster is a good deal more complex when faced with multicasting: the broadcaster must decide how many streams to broadcast, the quality of each stream, and the distribution of quality among the streams. The mathematics of this model are only slightly more complicated, because I do not attempt to understand in detail the decision for quality of each stream or the distribution of streams among streams. As before, the broadcaster faces the profit function in Equation (1). Now, however, advertising depends also on the number of multicast streams offered (S_S) according to:

$$A_S = a(P, Q_S, S_S, T(P)) \qquad (2a)$$[14]

$$Q_S = q(P, Q_R, S_S, T(P)) \qquad (3a)$$

[14] Some reviewers have found the equation numbering convention I employ confusing, although I am keeping it because I believe it is useful. To clarify: any equation number followed by an "a" refers to the decision faced by a broadcaster who multicasts; any equation number without the "a" is transmitting a single channel.

If S_S equals one, the decision facing the broadcaster is illustrated in Equation (5). As Equation (3a) illustrates, the decision of the level of quality to offer is now much more complicated in that the broadcaster must decide the number of streams to broadcast and the quality of each stream. This decision is also more directly affected by the structure of the market (T(P)), now included in the Q_S equation, for a variety of reasons. One reason is that rival multichannel providers may not carry every stream of programming a broadcaster offers. Another is that other broadcasters affect T(P) through their own decisions concerning multicasting.

Thus, the broadcaster selects a profit maximizing level of quality such that:

$$\begin{aligned}\partial \Pi_S / \partial Q_S &= \left(\partial \Pi_S / \partial A_S \; \partial A_S / \partial Q_S\right) + \left(\partial A_S / \partial Q_S \; \partial Q_S / \partial Q_R\right) \\ &+ \left(\partial A_S / \partial Q_S \; \partial Q_S / \partial S_S\right) - \partial C_S / \partial Q_S = 0 \text{ at } Q_S^{*}\end{aligned} \tag{4a}$$

and a profit maximizing number of multicast streams such that:

$$\partial \Pi_S / \partial S_S = \left(\partial \Pi_S / \partial A_S \; \partial A_S / \partial S_S\right) + \left(\partial A_S / \partial Q_S \; \partial Q_S / \partial S_S\right) - \left(\partial C_S / \partial Q_S \; \partial Q_S / \partial S_S\right) = 0 \text{ at } S_S^{*} \tag{4b}$$

The following implicit functions for quality and streams result:

$$Q_S^{*} = q(P, Q_R, T(P)) \tag{5a}$$
$$S_S^{*} = s(P, Q_R, T(P)) \tag{5b}$$

As does the following implicit function for profits:

$$\Pi_S^{*} = \pi\left[a(P, q(P, Q_R, T(P)), s(P, Q_R, T(P)), T(P)\right] \tag{6a}$$

Ultimately, the decisions concerning multicasting and quality for the broadcaster are very similar to the quality decision for one channel: the level of multicasting and the quality chosen by a broadcaster will depend on the population of the community (see

[Berry and Waldfogel (2010)]), the quality chosen by rivals, and the structure of the market. I expect that the quality chosen and number of streams shown by a broadcaster will increase as population increases, all else equal. The relationship between quality of rivals (which also includes rivals' levels of multicasting) and a broadcaster's quality and amount of multicasting will vary: as with no multicasting, broadcasters will choose a variety of profit-maximizing combinations of quality and multicasting. With the addition of multicasting, however, one complication will arise: while I expect that profits are increasing in the own number of streams offered, I also expect that there are diminishing marginal returns to offering more streams.[15] Thus, a broadcaster will experience diminishing marginal profits from additional multicasting. This, in turn, implies that all broadcasters will experience diminishing marginal profits from multicasting as the total amount of multicasting in a market increases (represented by T(P) in this model). This means that the decisions concerning the level of multicasting and its quality will be tied to the actions of all other participants in the market.

One final complication, only minimally reflected in the model presented here, is the presence of FCC ownership rules, and of statutorily mandated national ownership rules. Because these rules limit the scale and scope of broadcasters at both the local and national level, they may curtail the ability of broadcasters to absorb profitably the fixed costs necessary for some levels of multicasting, including in some markets any level of multicasting at all. For example, FCC rules forbid dual ownership of television stations in any market with fewer than eight voices, although there are exceptions to this rule.[16]

[15] More technically, I expect that $\delta\Pi^*/\delta s > 0$ but that $\delta^2\Pi^*/\delta s^2 < 0$.

[16] The exceptions include instances of financial distress and a number of grandfathering exceptions due to a change in FCC rules (the FCC previously had not considered local marketing agreements (LMAs) in the enforcement of this rule, but grandfathered exceptions at the time of the rule change). My guess is that

In these markets, then, it is possible that FCC rules will discourage multicasting because owners will be unable to increase their scale.

On the other hand, since these markets tend to be smaller, and there might be less total multicasting, there may be more room for additional broadcast channels in the markets, and thus more multicasting despite the smaller scale of broadcasters there. If this is true, it would link the FCC's diversity goal with its prohibition of certain kinds of consolidation. If markets where further television station consolidation is prohibited provide more multicasting, then at least a greater diversity of signals would be present, which is a necessary condition for a diversity of viewpoints.

In light of this theoretical model, one way to think about broadcaster multicasting decisions is to view each local market as consumers having a demand schedule for streams, or, more broadly, for entertainment and information options that correspond to streams of programming.[17] From the broadcaster perspective, each market has a demand for advertising, which is the source of revenue, and that demand for advertising will drive broadcaster decisions regarding streams of programming, both in terms of amount and quality. This links back to consumers because broadcasters sell advertising by connecting advertisers to consumers, and attract consumers through the programming they offer. Broadcast streams, with their local origination and thus offering some percentage of programming as locally-focused, occupy an important niche within the overall demand for channels of entertainment. This is because some forms of entertainment and information are interesting almost exclusively to a local audience (such

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occasional future exceptions might be granted due to financial distress, but that the FCC will allow few if any additional exceptions due to LMAs. As a result, the "eight voices" rule can be considered a partial bar to further consolidation in smaller markets, and this variable might measure the effect of such a bar.

[17] Defining content broadly allows for substitutes to multicast broadcast streams to take a variety of forms, such as cable channels or Internet content.

as weather and local sports), and thus national and regional levels of entertainment and sports will not function for close substitutes for broadcast streams. Facing this market, a broadcaster will decide whether to multicast, how much multicasting to offer, and the level of quality for each stream. Each broadcaster must make this decision in light of the other options available to consumers, including the amount and nature of multicasting offered in the market. For many (perhaps most) markets, the number of broadcast licenses available is limited,[18] creating a situation of scarcity for which multicasting is at least a partial solution.

An example of this might be a market in which there are five broadcasters. The first decides to multicast and puts on a weather feed and a broadcast of older movies. The second might do something similar, especially if their transmissions reach different areas, but the third might have incentive to broadcast different material, or not to multicast at all, especially if the market's population is small or if many other alternatives exist to the kind of content the third broadcaster might multicast. The fourth and fifth broadcasters would face similar decisions, and would face declining advertising revenues from similar programming, but might be able to find adequate advertising to support multicasting by serving other consumers, such as by multicasting Spanish-language programming or by creating a stream devoted to local sports. The decisions of all broadcasters would be affected by other local options, such as cable systems or local content offered on the Internet. This example illustrates how the decisions of broadcasters are intertwined, limited by the size and structure of the market, and related to other entertainment and information options available in each market.

[18] Or, similarly, the size of the market limits the number of broadcasters that can operate profitably, regardless of the number of licenses available.

I now turn to a description of the data I will use to estimate empirical models that will test the theoretical framework laid out above.

IV. Data

The data come from a large dataset of every broadcast television station in the country for the dates December 31, 2007 and December 31, 2009, generally referred to as Government Furnished Information (GFI) from the FCC. I then consolidated these data to the television market level to create the panel dataset I used for analysis. The resulting panel consists of 419 observations sufficiently complete for econometric analysis across the two years.[19] (See Table 1 on the following page for descriptive statistics.)

The data come from eight main sources. First, individual station data, and some market-level demographic data, come from the BIA Media Access Pro database (BIA). This database tracks the radio, television, and newspaper industries, and it provides a wide-range of data fields for each industry, both at the individual provider level, and at the ownership and parent ownership levels. It is an industry standard for detailed broadcaster information. Second, additional market-level demographic data were summed up to the television market level from the Census Bureau's American Community Survey (ACS) 2005-2009 five-year estimates. The ACS is an on-going survey of a sample of the population in the United States, and provides a wide variety of estimates on the demographic characteristics of communities. The relatively new five-year estimates provide data on communities of almost any size, whereas previous iterations were limited to communities above a certain population.

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[19] Although there are 210 television markets, some missing data from the New Orleans television market in 2007 due to the aftermath of Hurricane Katrina reduced the number of 2007 observations to 209. Missing observations in Internet data also reduced the number of observations in 2009 regressions to 205.

Table 1: Descriptive Statistics

Variable	2009 Regressions					2007 Regressions					Fixed Effects Regressions				
	N	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*N*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*N*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
Multicast Channel Count	205	17.927	11.555	1	89	209	15.033	9.484	1	56	419	16.415	10.632	1	89
Multicasting Intensity	205	2.292	0.451	1	3.5	209	1.944	0.475	1	3	419	2.119	0.493	1	4
Ratio of Commercial TV Stations to Parents	205	1.123	0.162	1	2	209	1.113	0.158	1	2	419	1.117	0.160	1	2
Commercial TV Stations	205	5.898	3.496	1	23	209	5.861	3.501	1	22	419	5.859	3.495	1	23
Noncommercial Non-PBS TV Stations	205	0.151	0.422	0	2	209	0.158	0.426	0	2	419	0.160	0.433	0	2
Commercial Multi-TV Station Parents	205	1.537	2.059	0	10	209	1.392	1.961	0	9	419	1.451	2.002	0	10
Eight or Fewer TV Voices	205	0.517	0.501	0	1	209	0.555	0.498	0	1	419	0.539	0.499	0	1
Minority-Owned TV Stations	205	0.234	0.621	0	6	209	0.196	0.541	0	5	419	0.217	0.581	0	6
Female-Owned TV Stations						209	0.344	0.625	0	4					
Local TV Parents	205	1.878	2.107	0	13	209	1.904	2.124	0	13	419	1.883	2.109	0	13
TV Stations with Radio Cross-Ownership	205	1.483	1.776	0	10	209	1.431	1.737	0	11	419	1.449	1.747	0	11
TV Stations with Newspaper Cross-Ownership	205	0.132	0.380	0	2	209	0.144	0.402	0	3	419	0.136	0.389	0	3
Missing 2007 Stations						209	0.536	0.826	0	4	419	0.267	0.642	0	4
Big 4 Affiliated Stations	205	3.546	0.967	1	6	209	3.507	0.971	1	6	419	3.513	0.977	1	6
PBS Stations	205	1.688	1.295	0	8	209	1.665	1.317	0	8	419	1.666	1.303	0	8
African American Population*	205	1.812	3.710	0.002	35.019	209	1.759	3.676	0.001	35.019	419	1.760	3.650	0.000	35.418
Hispanic Population*	205	2.150	6.773	0.003	75.394	209	2.172	6.735	0.002	75.393	419	2.224	6.911	0.001	78.188
Population with College or Greater Education*	205	2.631	5.123	0.043	49.476	209	2.589	5.083	0.011	49.476					
Population Over 25*											419	9.537	15.383	0.068	139.860
Retail Expenditures**	205	0.126	0.219	0.003	2.055	209	0.118	0.207	0.001	1.962	419	0.121	0.212	0.001	2.055
TV Households*	205	5.555	8.436	0.154	74.935	209	5.368	8.265	0.039	73.919	419	5.419	8.301	0.039	74.935
MVPD Households*	205	5.011	7.769	0.137	72.280	209	4.740	7.442	0.035	70.576	419	4.836	7.562	0.035	72.280
Percentage of Households with 768 kbps Downstream	205	0.509	0.113	0.174	0.980										
Year 2009											419	0.501	0.501	0	1

* In hundreds of thousands. (Values were scaled to allow easier reading of and interpreting of coefficients.)

** In hundreds of billions of dollars. (Values were scaled to allow easier reading of and interpreting of coefficients.)

Third, counts of broadcaster multicasting (and other variables calculated from multicasting counts), as well as some detailed data on the content of broadcasts, come from Tribune Media Services (TMS) TV Schedule data, which consist of detailed programming, channel, and schedule information for two separate two-week periods each year corresponding to broadcasters' "sweeps" weeks. TMS states that the dataset's main audience is entities seeking to create electronic programming guides, but the highly-detailed listings allow me to obtain an accurate count of muticasting, and also a detailed picture of the programming shown on multicast channels.

Fourth, to resolve conflicts between TMS and BIA data, we consulted the FCC's CDBS Electronic Filing System. CDBS is an electronic record of nearly 30 forms broadcasters are required to file electronically with the FCC. The data contained in CDBS include detailed filings on operating status, as well as data matching those in the BIA and TMS datasets, which allowed for completion of fields that were inadvertently left blank.

Fifth, data concerning female and minority ownership of television stations in 2007 come from Derek Turner of Free Press. The minority ownership data were extended to 2009 using the FCC's Form 323 filings, which show ownership as of November 1, 2009. Unfortunately, we were unable to extend the data on female ownership to 2009, so estimates for this variable appear only in regressions on 2007 data. Sixth, data on broadband penetration for 2009 come from the FCC's Form 477 data. Unfortunately, these data were only available for 2009, and thus the variable appears only in regressions on 2009 data. Seventh, some household counts come from The Nielsen Company.

Finally, we calculated a variety of variables based on the entries in a variety of our data sources. For example, the count of Local Television Parents is constructed from a count of the number of parent entities that also are located in the same television market. I provide further details on the origin of each variable in the description of the estimated models below. In general, we believe that we have assembled these data from the best data sources available, and have improved the quality of the data through further research. We thus believe that the dataset allow consistent estimation of the empirical models presented in the next section.

V. Empirical Models and Results

A. Empirical Models

The equations I estimated can be generally expressed as:

Multicast Channel Count = β0 + β1(Ratio Stations to Parents) + β2(Commercial Stations) + β3(Noncommercial Non-PBS Stations) + β4(Multiple Station Parents) + β5(Eight or Fewer Voices) + β6(Minority Owned Stations) + β7(Female Owned Stations) + β8(Local Parents) + β9(TV-Radio Cross-Owned) + β10(TV-Newspaper Cross-Owned) + β11(Missing 2007 Stations) + β12(Big 4 Stations) + β13(PBS Stations) + β14(African American Pop) + β15(Hispanic American Pop) + β16(College Plus Pop) + β17(Pop Over 25) + β18(Retail Expenditures) + β19(TV Households) + β20(MVPD Households) + β21(768 kbps) + β22(2009) + ε (7)

Multicasting Intensity = β0 + β1(Ratio Stations to Parents) + β2(Commercial Stations) + β3(Noncommercial Non-PBS Stations) + β4(Multiple Station Parents) + β5(Eight or Fewer Voices) + β6(Minority Owned Stations) + β7(Female Owned Stations) + β8(Local Parents) + β9(TV-Radio Cross-Owned) + β10(TV-Newspaper Cross-Owned) + β11(Missing 2007 Stations) + β12(Big 4 Stations) + β13(PBS Stations) + β14(African American Pop) + β15(Hispanic American Pop) + β16(College Plus Pop) + β17(Pop Over 25) + β18(Retail Expenditures) + β19(TV Households) + β20(MVPD Households) + β21(768 kbps) + β22(2009) + ε (8)

My empirical work consists of estimating these two equations three different ways each, differing only in the dependent variable and one or two independent variables, for a total of six separate estimated equations. First, I estimated both equations using Ordinary Least Squares for 2007 and 2009 separately.[20] These equations differed in that: female ownership data are only available for 2007, so this variable appears only in the 2007 equations; there is an issue with some missing stations in the 2007 data, so I include a control variable for this in the 2007 equations; and broadband penetration is available only for 2009, so this variable appears only in the 2009 equation. The remaining two estimations consist of regressions with year and market fixed effects, in order to account for unobserved characteristics of the individual television markets. Obviously, I could include neither female ownership nor broadband penetration in the fixed effects regressions, but the control variable for missing 2007 stations is included, as is a dummy variable for the year 2009 to account for changes in the dependent variables that occurred year-to-year otherwise not controlled for. Additionally, because the ACS demographic data are not appropriate to the fixed effects regression,[21] I substitute BIA demographic data for these equations.

While the theoretical model above informs the specification of the model, of course I acknowledge a significant difference: the theoretical model relates to individual broadcaster decisions while the empirical model uses market level data. The motivation for this decision is purely utilitarian: FCC regulations are set at the market level, and thus

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[20] A test of whether the pooling of observations across years is appropriate gave strong indication that the coefficients for 2007 observations are different than the coefficients for 2009 observations, that is, I reject the hypothesis that the coefficients are the same. The F-test for an accumulated test of the difference between 2007 and 2009 coefficients for Equation (7) is 8.62 and for Equation (8) is 3.26; both are significant at the 99 percent level of confidence. This fact should not be surprising given that the implementation of multicasting was nascent and was in a highly dynamic state across the two years covered by this study.

[21] ACS data are not appropriate for a fixed effects model across two years because they vary only due to changes in the communities included in each television market. Thus, the estimated coefficients might give misleading results since the underlying variation is not due to actual demographic changes. The substituted BIA demographic data vary year-to-year and thus are not subject to this limitation.

in this study I seek first to illuminate market level forces. Additionally, while individual broadcasters likely react differently to the forces at the market level due to their different characteristics, I believe that an aggregation of their decision to the market level provides useful insights into individual broadcaster incentives with regard to market level regulations. Finally, as noted in the final section, my further work on this issue includes examination of station level decisions concerning multicasting.

I note here that the juxtaposition of the year-specific and fixed effects regressions allows a check on some mistakes of interpretation that are possible with cross-sectional data (as used for the year-specific regressions) for which certain relevant characteristics are, by necessity, unobserved. Specifically, I have variables that adjust for certain characteristics of the markets by which the data are grouped but the limitations of available data, and the effects of multicollinearity, prevent adjustment for every market characteristic.[22]

The consequences of these unobserved characteristics for the year-specific regressions depend upon their nature. If the unobserved characteristics are correlated with the explanatory variables I do observe, then this can create a bias in the estimated coefficients for the year-specific regressions. Specifically, failing to control for unobserved market characteristics that affect the amount or intensity of multicasting and are correlated with any explanatory variables in the regression specification can lead to omitted variable bias in the estimated parameters. The standard issues with omitted variable bias arise: biased and inconsistent coefficient estimates. Because the precise

[22] Concerning an unobserved market characteristic, I did run regressions that adjusted for television markets that contain two or more major metropolitan areas, as opposed to television markets with only one. I tested two measures, but neither showed any significance in regressions nor changed any of the other results.

nature of the bias depends on presumably unknown facts concerning the relationship of the unobserved characteristics to the dependent variable and the observed characteristics, it is impossible to know how the estimated coefficients are affected. It is possible that the effect is large enough to reverse the sign of the estimated coefficients. Some of the estimates below may show such a large bias, as is discussed in the results section.

Under certain circumstances, a fixed effects estimator can correct for such biases. If the unobserved characteristics do not vary over time within markets, or if they vary in all markets in the same way over time, while the observed variables do vary over time and/or between markets, a fixed effects estimator can remove the bias resulting from the unobserved characteristics. The fixed effects estimator correlates changes in the observed characteristics with changes in outcomes, removing the effect of unobserved market characteristics that do not change over time or that change the same way for every market.

Of course, there is no free lunch, and the fixed effects estimator has its own problems. First, and most importantly, since the estimator correlates *changes* in the observed characteristics with market outcomes, the estimated results reflect the markets for which there was a change in the variable in question. As reported in Table 2, on the next page, many of the variables experienced change in only a few markets between 2007 and 2009, and thus significant fixed effects coefficients may be based on very few observations, placing a high premium on accurate market data, so that small errors in the data carry a heavy price. A related problem is that identification of coefficients with little year-to-year change is weak, leading to statistical insignificance. Finally, if the unobserved characteristics do vary year-to-year or differently for different markets, the fixed effects estimator will not remove the resulting bias.

Despite these limitations, the fixed effects estimator is useful for what it can do. I interpret the results in the following section in light of the differing or agreeing results of the year specific and fixed effects estimations.

Table 2: Dependent Variable Year-Over-Year Changes

Variable	**Changes**
Ratio of Commercial TV Stations to Parents	31
Commercial TV Stations	28
Noncommercial Non-PBS TV Stations	7
Commercial Multi-TV Station Parents	23
Eight or Fewer TV Voices	14
Minority-Owned TV Stations	16
Local TV Parents	28
TV Stations with Radio Cross-Ownership	19
TV Stations with Newspaper Cross-Ownership	5
Missing 2007 Stations	79
Big 4 Affiliated Stations	14
PBS Stations	7
African American Population	210
Hispanic Population	210
Population Over 25	210
Retail Expenditures	210
TV Households	210
MVPD Households	210

B. Variables

Each variable, except as otherwise noted, is compiled for the end of 2007 and 2009. The variables are more precisely defined as follows:

Dependent Variables

1. *Multicast Channel Count*: Using TMS data, which includes programming and schedule data on every broadcast television transmission, including multicast transmissions, I summed up for each television station licensee its total number of transmissions. Stations broadcast between one and ten streams of programming.[23] These totals were then summed up to the television market level. The *Multicast Channel Count* is intended as a gross measure of the level of innovation by television broadcasters in each market.[24]

2. *Multicasting Intensity*: This is the total number of signals broadcast in a television market divided by the total number of stations. It is intended as a measure of how efficiently the spectrum available to broadcasters is being used, and thus a measure of the intensity of innovation.

Independent Variables

1. *Ratio of Commercial Television Stations to Parents*: This variable was calculated by summing individual commercial television station observations from BIA to the television market level, and dividing it by a count of parent entities by market, also

[23] I realize that stations broadcasting one stream are not technically "multicasting" but it is a measure of the use of the spectrum in the market to include them.

[24] I examined a few other dependent variables. I made an attempt to create a measure of "value added" multicasting, or the number of multicast signals with a different network affiliation than the primary station broadcast. It did not show any significant difference with the results of total multicasting. There is some imprecision to the affiliation variables, so this makes any interpretation of results from such a variable unclear. I also tested a couple of other multicasting counts, such as a count of the number of stations per market broadcasting more than one stream and more than three streams; the results were very similar to the results presented here.

derived from BIA. As noted above, the FCC's rules contain a general prohibition against owning more than two stations in one television market, with some additional restrictions. While there are a couple of exceptions to this rule, it holds in the vast majority of markets. Thus, this variable ranges between one and two, and the closer the value for a market is to two, the closer a market is to the theoretical limit of the FCC's rules. It is the policy variable of primary interest, and is intended as a measure of the relationship between innovative activity, market structure, and FCC rules. I believe this a better measure than a simple count of the number of television voices or other counts of voices, because it accounts for the effect of FCC regulations on market structure. An insignificant coefficient indicates FCC rules do not affect market structure in such a way as to affect this innovative activity. A significant and positive coefficient means that as a market approaches the concentration limit imposed by FCC rules, innovative activity increases. One possible interpretation of this result could be that further consolidation would support further innovation. A negative coefficient means the opposite.

2. *Commercial Television Stations* and *Noncommercial Non-PBS Television Stations*: These represent simple counts for each television market of commercial and noncommercial non-PBS television stations from BIA, and represent a control for the simple fact that some markets (generally larger markets) have more stations and multicast streams than others. I expect positive coefficients for at least the multicast channel count equation, indicating more multicasting with more stations. I separated out noncommercial non-PBS stations from PBS stations to see if their behavior differed. (See the description of *PBS Stations*, below.)

3. *Multiple Station Parents*: This variable is a count for each television market of the number of commercial television stations owned by parent entities that own more than one television station, and it was calculated using BIA station-level station and parent information, summed up to the television market level. It is a concentration measure, and shows the effect of the allowance within FCC rules for a single entity to own two (or occasionally more) stations.[25] A positive and significant coefficient implies that additional multiple ownership inspires more innovation, and a negative coefficient implies the opposite.

4. *Eight or Fewer Voices*: This variable is an indicator variable that equals one for any market in which there are eight or fewer television voices and no waiver of the prohibition against combinations in these markets has been granted.[26] It was calculated from the *TVVoices* variable, which is calculated from BIA data, and is a count of the number of independent television voices in each market. Under FCC rules, no further consolidation among television owners is allowed (absent a waiver) in markets for which eight or fewer voices would result. It represents a measure of innovative activity in markets in which further consolidation among television stations is at least unlikely. Presumably, television station owners in these markets realize that further consolidation is difficult and will make multicasting decisions accordingly.

5. *Minority Owned Television Stations*: This variable is a total by television market of television stations controlled by minorities, and it measures whether minority-

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[25] While this variable measures something very similar to the *Ratio of Commercial Television Stations to Parents*, and is highly correlated (0.7893) with it, this variable is a count with no scaling for the total number of stations in the market, whereas the *Ratio of Commercial Television Stations to Parents* is directly comparable across all markets. Out of concern for multicollinearity, I also ran regressions without this variable, but the results were not very different but statistically inferior.

[26] Thus, in any market in which a waiver of the rule has been granted, this variable equals 0.

controlled stations behave differently with regard to innovation. The 2007 values are as of October 1, 2007, and were summed up to the television market level from station-level data from Derek Turner of Free Press,[27] and 2009 values were derived from the FCC Form 323, and are as of November 1, 2009.

6. *Female Owned Television Stations*: This variable is a total by television market of television stations controlled by women, and it measures whether female-controlled stations behave differently with regard to innovation. The 2007 values are as of February 2007 and were summed up to the television market level from station-level data from Derek Turner of Free Press.[28] As noted, this variable is not available for 2009, so that it only appears in the 2007-specific regressions.

7. *Local Parents*: At the television station level, the GFI data contain an indicator variable that equals one if the *ParentZip* (the zip code for the address of the Parent entity of the station) is located in a county in the television station's television market, and I summed this variable up to the television market level. I intend this variable to show whether locally-owned entities behave differently with respect to innovation. It could be interpreted as an indirect measure of how the FCC's underlying goal of localism affects innovation, but it is important to temper this interpretation since local ownership does not necessarily translate into local content.

8. *Television-Radio Cross-Owned Stations* and *Television-Newspaper Cross-Owned Stations*: Within each television market, the GFI data include a count of television

[27] As noted in the data documentation, if the station license was transferred between October 2007 and December 2007, the station-level value for 2007 may be inaccurate, which may propagate up to the television market level.

[28] As noted in the data documentation, if the station license was transferred between October 2007 and December 2007, the station-level value for 2007 may be inaccurate, which may propagate up to the television market level.

stations owned by a parent entity that also owns either at least one radio station or daily newspaper, respectively, within the same television market.[29] The GFI ownership information was derived from station-level data from BIA, as used by all study authors. These two variables measure whether television cross-ownership affects innovative activity, and thus indicate whether and how FCC rules for cross-ownership affect innovative activity.

9. *Missing 2007 Stations*: TMS data for 2007 contained information on 151 fewer television stations than BIA data for the markets we include in this study. We created an indicator variable at the station-level for any station that appears in the BIA data but not in the TMS data. Many of these stations appear to be analog-only, but others had already made the digital switch, so the reason for the discrepancy is unclear. This discrepancy could cause the count of multicast streams to be inaccurate, and thus also the measure of multicasting intensity. The default position is that the BIA data are the base data, so I corrected for this discrepancy in a couple of ways. First, I replaced empty values for multicasting at the station-level for 2007 for these stations with their respective values for 2005 (the vast majority were broadcasting only one stream in 2005). While I assume that not all of these stations were doing the same thing in 2007 as in 2005, it seemed more conservative than using what they were doing in 2009, which may result in overcounting multicasting since it has tended upward over time. Second, to account for potential undercounting of multicasting due to using 2005 values for these stations, I summed the indicator variable up to the market level and used it in the 2007-specific and fixed effects regressions. Most markets are missing either no stations or one station, but a few are

[29] To be counted, newspapers must meet the requirements set forth in C.F.R. 73.3555(d). Other caveats concerning the accuracy of these measures are contained in the data documentation.

missing more. I expect the coefficient for this variable, at least for the count of Multicasting, to be negative since multicasting has trended upward over time.

10. *Big 4 Stations*: This variable is a count by market of stations affiliated with the "Big 4" networks (ABC, CBS, Fox, or NBC), and was constructed using network affiliation data from BIA. For stations with multiple affiliations, I used the primary affiliation for this variable. Across 2007 and 2009, 22 markets show values greater than four (either five or six) for this variable. I debated truncating the values at four because, in general, I believe there is very little or no overlap of the broadcasts of stations affiliated with the same Big 4 networks within one market. Ultimately, however, I ran the regressions both ways and there was very little difference between the two, so I left the variable unchanged. This variable measures whether Big 4-affiliated stations pursue innovative activity differently, and could be considered a rough measure of how the FCC's rule prohibiting a merger between Big 4 networks relates to innovation. I vaguely expect that networks affiliated with the Big 4 will pursue more multicasting, perhaps due to better access to financing and content.

11. *PBS Stations*: This variable is a count by market of stations affiliated with the Public Broadcasting System (PBS), and was constructed using network affiliation data from BIA. For stations with multiple affiliations, I used the primary affiliation for this variable. This variable measures whether PBS-affiliated stations pursue innovative activity differently than non-PBS stations.

12. *African-American Population* and *Hispanic Population*: These variables are counts of the African-American or Hispanic population by television market, and are simply controls for demographic factors. For the year-specific regressions, I used ACS

data. Because ACS data vary between 2007 and 2009 only due to changes in the communities contained within each market, they are not appropriate to the fixed effects regressions, so I substituted BIA data for these variables for the fixed effects regressions.

13. *College Plus Population* and *Population Over 25*: These variables are counts of individuals who hold at least a Bachelor's degree and/or who are older than 25 years of age, respectively, by television market, and again are simply controls for demographic factors. For the year-specific regressions, I used *College Plus Population*, calculated from ACS data: this variable counts individuals who are both over 25 and hold at least a Bachelor's degree.. Because ACS data vary between 2007 and 2009 only due to changes in the communities contained within each market, they are not appropriate to the fixed effects regressions, so I substituted BIA data for the fixed effects regressions. Unfortunately, the BIA data do not include education demographics, so I substituted as a rough proxy, the population count of those older than 25.

14. *Retail Expenditures*: This variable measures the total retail expenditures per market for the entire year in question, and comes from BIA. It is used in every regression because it comes from BIA and thus is not subject to the objections noted above (see the explanation for the *African American Population* and *Hispanic Population* variables) for ACS data in the fixed effects regressions. The documentation notes, however, that BIA switched data providers for these data between 2007 and 2009, so there is some chance that at least some of the changes year-to-year reflect differences in the way the two vendors collect data rather than actual changes in retail expenditures. The variable is intended as a control for total economic activity, which also can function as a proxy for

income,[30] and will show a rough measure of how innovative activity varies due to total advertising potential for a television market.

15. *Television Households*: This variable is a count of the total number of television households per television market, and comes from The Nielsen Company. It is a control for total size of the market, or population in the theoretical model above, and I generally expect that at least multicasting will increase with a larger population.

16. *MVPD Households*: This is a count of the total number of households subscribing to a multichannel video program distributor, such as a cable operator or satellite provider, and it is also calculated from data from The Nielsen Company. The expectation of the sign of the estimated coefficients is somewhat more complicated than that for *Television Households* because MVPDs represent both potential distributors of multicast programming and competitors showing their own group of "multicast" channels. Notably, FCC regulations require MVPD carriage (with many complications I will not cover here) of the primary multicast signal, but do not require carriage of the balance of multicast signals broadcast by a television station. Some of these signals are carried and some are not, so the expectation is not clear. In particular, if broadcasters are able to gain carriage for all or a high percentage of their signals, I would expect a positive sign. If instead MVPD providers view broadcaster multicasting as a serious competitive threat, they might foreclose carriage and thus I would expect a negative sign.

17. *768 kbps*: This variable represents the percent of households per television market subscribing to a broadband provider and having access to at least 768 kilobits per

[30] I can preempt some potential objections to the use of this variable by disclosing that I also ran regressions using household median income, both in place of and in concert with the *Retail Expenditures* variable. There was no appreciable difference in using the various variables, so I chose to stick with *Retail Expenditures* because I believe common sense supports the idea that broadcasters and advertisers care more about how much people spend in a market than about how much the average household earns.

second (kbps) throughput downstream, that is, coming into the household, and 200 kbps upstream. It was calculated by FCC staff using data as of June 30, 2009 from the FCC's Form 477, and is aggregated from the census tract to the television market level. These data are available only for 2009, and so they appear only in the 2009-specific regressions.[31]

18. *2009*: This is an indicator variable that equals one if the observation in question occurs in the year 2009. It is a control for unobserved changes year-to-year in the fixed effects regressions. My general expectation is that it the estimated coefficient at least for the multicasting count equation will be positive since multicasting was expanding between 2007 and 2009.

C. Results

The results are summarized in Table 3, below:[32]

[31] I tested several different means of measuring the effect of broadband, such as also using the 200 kbps downstream percentage and the average number of broadband providers, both together with *768 kbps* and separately, but the results did not change much. The one exception was a near-significant positive estimated coefficient for the *Average Number of Mobile Broadband Providers* in a version of the 2009-specific multicasting intensity equation. I tend to give little weight to this result because it was isolated, does not rise to the 95% level of confidence, and the magnitude of the coefficient was quite small. My general approach is to look for more consistency in results to overcome the caution that correlation does not imply causation. For simplicity, I reported the results using one measure.

[32] To control for unobserved heteroskedasticity, common in this sort of panel and cross-sectional data, I calculate heteroskedastic-robust standard errors. Additionally, the fixed effects procedure I employ corrects the standard errors for correlation across years within markets.

Table 3: Summary of Regression Results

	Dependent Variable: Multicast Channel Count					
Model Specification:	*2009*	*t-statistic*	*2007*	*t-statistic*	*Fixed Effects*	*t-statistic*
Ratio of Commercial TV Stations to Parents	-2.306	0.68	2.903	1.29	-2.399	0.34
Commercial TV Stations	1.828***	6.87	1.672***	9.07	1.122	1.43
Noncommercial Non-PBS TV Stations	1.214	1.48	1.177*	1.96	2.590**	2.48
Commercial Multi-TV Station Parents	-0.181	0.46	0.128	0.38	-0.525	0.68
Eight or Fewer TV Voices	-2.169**	2.20	1.210	1.29	-1.570	0.93
Minority-Owned TV Stations	0.807	1.28	0.660	0.93	0.517	0.57
Female-Owned TV Stations			0.894***	2.69		
Local TV Parents	-0.407**	2.38	-0.192	1.01	0.416	0.83
TV Stations with Radio Cross-Ownership	-0.296	1.31	-0.675***	3.26	1.902**	2.19
TV Stations with Newspaper Cross-Ownership	-0.354	0.53	0.604	1.00	1.360	1.12
Missing 2007 Stations			-1.184***	3.66	-1.191***	3.15
Big 4 Affiliated Stations	-0.415	1.38	-0.260	0.94	0.048	0.06
PBS Stations	4.202***	18.34	3.509***	14.05	1.842	1.83*
African American Population	0.088	0.51	0.129	0.66	-0.922	0.64
Hispanic Population	0.175**	2.07	-0.195**	2.30	-4.629	1.47
Population with College or Greater Education	-1.994**	2.16	-1.411	1.53		
Population Over 25					-0.821	0.63
Retail Expenditures	95.889**	2.57	44.456	1.10	9.380	0.18
TV Households	0.515	0.60	1.136*	1.90	0.425	0.09
MVPD Households	-1.823**	2.54	-1.303**	2.01	7.115**	2.44
Percentage of Households with 768 kbps Downstream	1.697	0.79				
Year 2009					1.358***	5.63
Constant	4.416	1.06	-3.861	1.31	-11.823	0.78
Number of Observations	**205**		**209**		**419**	
F-Statistic	**175.95*** **		**249.76*** **		**16.72*** **	
Adjusted R-Squared†	**0.9476**		**0.9256**		**0.6722†**	

	Dependent Variable: Multicasting Intensity					
Model Specification:	*2009*	*t-statistic*	*2007*	*t-statistic*	*Fixed Effects*	*t-statistic*
Ratio of Commercial TV Stations to Parents	0.231	0.27	0.811	1.31	-1.455**	2.46
Commercial TV Stations	-0.034	0.96	0.017	0.57	-0.188**	2.53
Noncommercial Non-PBS TV Stations	0.033	0.44	0.007	0.12	-0.023	0.15
Commercial Multi-TV Station Parents	-0.025	0.35	-0.032	0.56	0.082	1.24
Eight or Fewer TV Voices	-0.115	0.92	0.206*	1.71	-0.126	0.79
Minority-Owned TV Stations	0.041	0.61	0.052	0.70	-0.098	1.31
Female-Owned TV Stations			0.084**	2.10		
Local TV Parents	-0.059***	2.87	-0.039*	1.88	0.076*	1.87
TV Stations with Radio Cross-Ownership	-0.039	1.59	-0.083***	3.69	0.147**	2.14
TV Stations with Newspaper Cross-Ownership	0.075	1.01	0.133*	1.93	0.211***	3.61
Missing 2007 Stations			-0.162***	4.43	-0.083**	2.49
Big 4 Affiliated Stations	-0.105*	1.81	-0.114**	2.04	0.046	0.49
PBS Stations	0.226***	8.00	0.210***	7.07	-0.067	0.48
African American Population	0.009	0.59	0.005	0.30	-0.023	0.22
Hispanic Population	0.004	0.58	-0.020**	2.50	-0.222	1.38
Population with College or Greater Education	-0.171**	2.11	-0.116	1.43		
Population Over 25					-0.086	0.83
Retail Expenditures	6.100*	1.83	2.157	0.60	0.515	0.16
TV Households	0.064	0.87	0.125**	2.31	0.150	0.50
MVPD Households	-0.118**	2.07	-0.100*	1.74	0.102	0.65
Percentage of Households with 768 kbps Downstream	0.352	1.03				
Year 2009					0.308***	9.00
Constant	2.178**	2.21	1.020	1.38	4.241***	3.55
Number of Observations	**205**		**209**		**419**	
F-Statistic	**7.70*** **		**12.48*** **		**20.70*** **	
Adjusted R-Squared†	**0.2647**		**0.3466**		**0.5855†**	

* Significant at the 90% level of confidence; ** 95% level of confidence; *** 99% level of confidence.

† Within R-Squared for the Fixed Effects Regressions.

Critically for the subject of this study, the estimated coefficients for the main measure of the interaction between market structure, FCC regulations, and innovation as measured by multicasting, *Ratio of Commercial Television Stations to Parents*, is not significant at conventional levels in all but one of the regressions.[33] In the case of the multicast channel count regressions, both the year-specific and the fixed effect regressions are statistically insignificant. This indicates that FCC regulations, and their effect on market structure, are not having an impact on the amount of or innovative activity during this period. Thus, I would not expect a continuation of such regulations to affect innovative activity, at least as it has been measured for these regressions.

For the multicasting intensity regressions, however, the story is different. While the estimated coefficients for the year-specific regressions are statistically insignificant, in the fixed effects regression it is statistically significant. Specifically, the fixed effects coefficient is significant at the 95 percent level of confidence and negative, indicating that multicasting intensity, which I interpret as innovation intensity, increases as market concentration decreases, or as the number of station owners approaches the number of stations, adjusting for unobserved market characteristics. This could be interpreted as indicating that FCC regulations support innovation since the regulations limit consolidation, but there is reason to be cautious about this interpretation. In the discussion above of fixed effects regressions, the results turn on markets in which the variable changed over time. As indicated in Table 2, the *Ratio of Commercial Television Stations to Parents* changes for only 31 markets, a small number of observations for any estimation. Any inaccuracy in the data for these markets could have a drastic effect on

[33] In addition to this ratio measure, I also tested other available measures of market structure, such as the total number of television voices, and the total number of television, radio, and newspaper voices. These measures performed similarly to the one reported.

the estimation, as would violations of other assumptions underlying fixed effects regressions, so this interpretation should be treated cautiously.

As expected, the estimated coefficients for the *Commercial Television Stations* variable are positive and highly significant for the multicast channel count year-specific regressions, but the estimated coefficient drops below conventional significance for the multicast channel count fixed effects regression. As noted above in the general discussion of the fixed effects regressions, the fixed effects regression estimation turns on markets that experienced changes in the variables, which is limited to 28 markets for this variable, so some caution in interpretation of the fixed effects result is called for. The combination of statistically significant cross-sectional estimations and statistically insignificant fixed effects regressions suggests that there are unobserved market characteristics that are correlated with the multicast count and *Commercial Television Stations*, thus biasing the year-specific regressions.[34] A conservative interpretation of these results in combination is that some unobserved market characteristics correlated with *Commercial Television Stations* drive increased multicasting but that the simple presence of additional *Commercial Television Stations* does not.[35]

In contrast, the estimated coefficients for *Commercial Television Stations* are not significant for the year-specific multicasting intensity regressions, but the estimated

[34] I include this discussion in a footnote because the fixed effects result should cause extreme caution in interpretation of the year-specific regressions. To the extent that we believe the year-specific regressions in light of the fixed effects result, the magnitude of the estimated coefficients for *Commercial Television Stations* in the year-specific regressions indicates that for each additional commercial television station, a market gains nearly two multicast streams. This is evidence that additional *Commercial Television Stations* multicast at a declining rate, because the first multicast signal, as I calculated it, is the primary signal. This result is consistent with the assumptions behind and the predictions of the theoretical model.

[35] I have no evidence to support this idea, but one unobserved characteristic I can imagine that could be correlated with *Commercial Television Stations* is the relative value of cable television service in the market. Low-cost, high-value cable service could be correlated with fewer *Commercial Television Stations* and multicasting, and high-cost, low-value cable service could be correlated with more of both. I adjust somewhat for this possibility with the *TV Households* and *MVPD Households* variables, but not completely, I would guess.

coefficient is significant, and negative, for the fixed effects multicasting intensity regression. This indicates that there are unobserved market characteristics that are correlated with multicasting intensity and *Commercial Television Stations*. Once adjusted for in the fixed effects regression, the significant and negative coefficient indicates that additional *Commercial Television Stations* result in declining multicasting intensity. This result is consistent with the theoretical model, in that it indicates that the more stations there are, the less multicasting there will be, perhaps simply due to a declining marginal utility for additional channels.

The estimated coefficients for the *Noncommercial Non-PBS Television Stations* variable are close to significant at conventional levels for the multicast channel count year-specific regressions, but positive and highly significant for the multicast channel count fixed effects regression. The later indicates that unobserved market characteristics correlated with *Noncommercial Non-PBS Television Stations* bias the year-specific regressions. Even more than for previous variables, however, this result should be treated cautiously, because it turns on only seven markets in which the number of *Noncommercial Non-PBS Television Stations* changed between 2007 and 2009. The magnitude of the coefficient in the fixed effects regression, 2.590, shows a greater than one-to-one gain in multicasting with an additional noncommercial non-PBS television station, or more than 1.5 additional multicasting streams above the primary. None of the estimated coefficients for *Noncommercial Non-PBS Television Stations* are significant for the multicasting intensity regression, indicating no statistically significant relationship between market multicasting intensity and the number of noncommercial non-PBS television stations.[36]

The estimated coefficients for *PBS Stations* are highly significant and positive for all of the year-specific regressions, and not significant for either of the fixed effects regressions (although near-significant for the multicast channel count fixed effects regression). The lack of significance in the fixed effects regressions may be driven by the fact that not much change occurred between 2007 and 2009: as shown in Table 2, only seven markets have a different number of PBS stations in 2009 than in 2007, and the change is never by more than two stations (for one market, one station change for the rest). Thus, while the fixed effects regressions indicate that the year-specific regressions may be biased, I still offer an interpretation of the year-specific regressions since the fixed effects regressions may be affected by the low number of observations on which they depend. The magnitude of the coefficients for the multicast channel count year-specific regressions, between three and just over four, along with the highly significant and positive coefficients for the multicasting intensity year-specific regressions, indicate increasing multicasting and increasing multicasting intensity use, or increasing innovation and intensity of innovation, with additional PBS stations. It is not clear why this is true: perhaps PBS stations have access to cheaper content than other noncommercial stations or the average television station. Alternatively, since PBS stations are both donor-supported and government-subsidized, perhaps differences in their business models support more multicasting.

[36] In essence, this probably means simply that noncommercial television stations behave like the average television station in a given market, in that they use their spectrum roughly as intensively as all stations.

None of the estimated coefficients for *Multiple Station Parents* are significant in any regression. These results indicate that another aspect of FCC broadcast ownership rules, of allowing some instances of joint ownership of television stations within some television markets, also does not have a statistically significant effect on the amount of or intensity of innovation as measured herein. Since significant and positive estimated coefficients would indicate that these combinations increase innovation, these results also do not provide support for the idea that allowing additional consolidation in this manner would increase innovation.

None of the estimated coefficients for *Eight or Fewer Voices* are statistically significant for the multicasting intensity regressions, indicating that the FCC's prohibition against further television station ownership in these markets does not affect the intensity of innovation. For the multicast channel count regressions, no clear pattern emerges. The estimated coefficient is significant and negative for the 2009-specific multicast count regression, but not significant for the 2007-specific and fixed effects multicast channel count regressions. As before, the fixed effects regressions turn on only the markets that showed a change in this variable, only 14 markets, so attaching too much importance to the fixed effects result is unwise. One possible interpretation is that the 2009 result for multicast count shows that the prohibition against consolidation in these markets may be limiting the amount of multicasting as multicasting increases over time. Together, these results provide weak evidence that FCC prohibition against further consolidation in these markets may be reducing the total amount of multicasting in these markets, but there is no indication that further consolidation would increase the intensity of use of the spectrum available to broadcasters in these markets.

None of the estimated coefficients for *Minority Owned Television Stations* are significant in any regression. These results indicate that minority ownership of television stations does not have a statistically significant effect on the amount of or intensity of innovation as measured herein. The estimated coefficients for *Female Owned Television Stations*, however, are positive and significant for both 2007-specific regressions, indicating that female ownership leads to more total multicasting and more intensive use of spectrum. Of course, it would be helpful to see the results for more than one point in time to get a more complete picture of the effects of female ownership. Additionally, the small magnitude of the coefficients indicates that a market gains far less than one additional stream per additional female owner.

The estimated coefficients for *Local TV Parents* are significant for both 2009-specific regressions, but not for any of the other regressions (although they are near-significant for the 2007-specific and fixed effects multicasting intensity regressions). As with other variables with similar results, the fixed effects results indicate that unobserved market characteristics correlated with *Local TV Parents* drive the 2009-specific results. As Table 2 shows, however, the fixed effects regressions turn on 28 markets for which there was a change in this variable.

The estimated coefficients for radio cross ownership, *Television-Radio Cross-Owned Stations* are inconsistent: for both the multicast count and multicasting intensity regressions, the coefficients are insignificant for 2009, significant and negative for 2007 (with a high level of significance but a small magnitude), but significant and positive for the fixed effects regression. The fixed effects regressions depend upon only 19 markets in which a change occurred. These results may mean that some change between 2007 and 2009 changed the influence of radio cross-ownership. The fixed effects result indicates that an additional television station with radio cross-ownership results in just less than one additional multicast stream and a slight increase in multicasting intensity.[37]

None of the coefficients for *Television-Newspaper Cross-Owned Stations* are significant for the multicast count regressions. For the multicasting intensity regressions, they are positive and significant for the 2007 and fixed effects regressions, but insignificant for the 2009 regression. The fixed effects regression depends upon only five markets. Given the inconsistency (it is a strange result that there is no effect on the number of multicast streams but there is an effect on multicasting intensity) and the small number of markets driving the fixed effects regressions, I am reluctant to derive a conclusion from this variable, other than I find no reason to believe that newspaper cross-ownership detracts from innovation.

Not surprisingly, the estimated coefficients for *Missing 2007 Stations* are negative and highly significant for the regressions in which they appear, indicating that I undercount both the amount and intensity of innovation in the markets with mission 2007 observations. As noted above, in markets for which TMS data lacked station-level data in 2007, I replaced multicasting counts with 2005 values, which I view as a conservative choice over using 2009 values. Apparently, the amount of multicasting for these stations

[37] As an alternative to *Television-Radio Cross-Owned Stations* (a count per market of the number of television stations owned by a parent that owns at least one radio station), I also tested a measure for the average number of radio stations owned by television parents (with a separate variable to account for markets with no cross-owned radio stations). My thinking was that a market in which several television parents owned one radio station might show different results than a market in which one television parent owned many radio stations. This reasoning does not appear to be correct: instead, to the extent that television-radio cross-ownership affects innovation, it appears that the presence of cross-ownership, not the distribution, is the relevant characteristic. I did not bother with a similar procedure with newspaper cross-ownership because it is extremely rare or non-existent for a television parent to own more than one newspaper in a given market.

missing from the 2007 TMS data increased between 2005 and 2007. I am hopeful that the inclusion of *Missing 2007 Stations* adequately controlled for the missing data.

The estimated coefficients for *Big 4 Stations* are not significant for either of the fixed effects regressions (perhaps due to the small number of year-over-year changes, 14) and also are not significant for the multicast count year-specific regressions. The estimated coefficients are negative and significant or near-significant, however, for the year-specific multicasting intensity regressions, a result that slightly surprised me. I expected positive coefficients generally for this variable because I assumed these stations might have greater financial resources and better access to content. Apparently this is not true, or the relationship is not what I expected.[38] In any event, affiliation with the Big 4 networks does not appear to affect the amount of multicasting and might be somewhat negative for intensity of multicasting, depending on why the fixed effects coefficients are not significant. This may provide weak support for the idea that the FCC's prohibition against the merger of Big 4 networks also protects innovation.

None of the estimated coefficients for *African American Population* are significant in any regression. These results indicate that African American population does not have a statistically significant effect on the amount of or intensity of innovation as I measured it. The estimated coefficients for *Hispanic Population* are inconsistent, but they are not significant for either of the fixed effects regressions. Given that there is plenty of variation year-to-year for each demographic variable (not surprisingly, each demographic variable changed in every market), the insignificant result for the fixed effects regressions

[38] I thank Jonathan Levy for the insight that Big 4 broadcasters might be more likely to broadcast high definition programming, which requires more of the available spectrum, and thus might have less available spectrum for muticasting.

indicates that unobserved market characteristics drive any year-specific significant results.

The estimated coefficients for *Population Over 25* are not statistically significant for either fixed effects regression. The estimated coefficients for *College Plus Population* are all insignificant for 2007-specific regressions but significant for the 2009-specific ones. If *Population Over 25* is functioning as a good proxy for *College Plus Population* for the fixed effects regressions, the fixed effects results cast doubt on the 2009-specific multicast channel count result.

The three measures of market size, *Retail Expenditures*, *Television Households*, and *MVPD Households* may tell a more interesting story. The estimated coefficients for *Retail Expenditures* are insignificant, except for the 2009-specific multicast count regression, which is significant, positive, and has an extremely large magnitude.[39] One possible interpretation is that the industry is transitioning from an earlier, more experimental stage in multicasting to a new stage in which broadcasters are attempting to profit from the additional streams.

The estimated coefficients for *Television Households* are significant or borderline significant and positive for the 2007 specific regressions and insignificant otherwise. Collinearity with both *Retail Expenditures* and *MVPD Households* may affect the results of *Television Households*. The estimated coefficients for *MVPD Households*, however, are negative and significant for all of the year-specific regressions, although borderline significant for the 2007 multicasting intensity regression.

In isolation, these results indicate that failing to require multichannel video providers to carry multicast stream may discourage this form of innovation and its intensity,

[39] The 2009 multicasting intensity regression coefficient is borderline significant.

although the magnitude of the coefficients is quite small: every one hundred thousand additional MVPD households results in a reduction of between one and two multicast streams per market. The fixed effects results confuse this result: the coefficient is insignificant for the multicasting intensity fixed effect regression, but the coefficient switches sign to positive for the multicast count fixed effect regression, with a magnitude indicating that a market gains more than 7 programming streams for each additional one hundred thousand multichannel households. Certainly, the confusing nature of this discrepancy invites further study: it indicates that there is some unobserved market characteristic correlated with *MVPD Households* that has a profound influence on the outcome.[40]

The estimated coefficients for *768 kbps* are not significant for the two 2009-specific regressions in which they appear. These results indicate that broadband penetration does not have a statistically significant effect on the amount of or intensity of innovation as measured herein. As noted above, other possible measures of broadband penetration or of broadband availability also do not show any significant effect on multicasting. Perhaps it is early in the process of broadband Internet providing a competitive effect on programming distributors and that broadband penetration will have a greater effect in the future.

Finally, the indicator variable *Year 2009* is significant and positive in both fixed effects regressions. This indicates that both the amount of multicasting per market and the intensity of the multicasting use of spectrum increased between 2007 and 2009, even

[40] The discussion above found in footnote 35, concerning cable-system quality and price, may also be relevant here.

when adjusted for unobserved market factors. Whether this trend will continue is unclear, but it bears future monitoring.

VI. Conclusion

I set out to examine the relationship between market structure, FCC broadcast ownership regulations, and innovation amount and intensity. To accomplish this, FCC staff developed a large dataset on broadcast stations and market structure, and I created several measures of the intersection of market structure and FCC regulations, chiefly the ratio of commercial television stations to commercial television parents. To measure innovation amount, I calculated the total amount of broadcast multicasting per market, and to measure innovation intensity, I calculated the average number of multicasts per television station in each market. In general, the interaction between market structure and the FCC's broadcast television ownership rules does not appear to have a statistically significant impact on either the amount of or intensity of innovation, as I measured it, or it may have a slight positive effect. The number of stations, particularly the number of PBS stations, seems to be the main factor affecting the amount of multicasting. Other factors displayed a good deal of inconsistency depending on the form of the regression, perhaps due to the fact that broadcasters may still be trying to figure out how best to profit from multicasting.

Of the variables returning inconsistent results, local ownership measures, cross ownership measures, and the amount of MVPD households are of particular interest. Because these measures implicate FCC goals or regulations concerning localism, ownership limitations, or carriage requirements, I recommend further study of these measures and of their effect on multicasting and other market activities. Future media ownership studies will have the benefit of additional years of data and perhaps a stabilizing multicasting market. For my part, I will continue to study this relationship as time allows, and I intend to separate commercial and noncommercial stations into separate equations to see if differences arise and to examine multicasting decisions at the station level.

VII. Bibliography

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