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Responses to Entry in Multi-Sided Markets: The Impact of Craigslist on Local Newspapers

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How do firms respond to entry in multi-sided markets? We address this question by studying the impact of Craigslist, a website providing classified-advertising services, on local U.S. newspapers. We exploit temporal and geographical variation in Craigslist's entry to show that newspapers with greater reliance on classified-ad revenue experience a larger drop in classified-ad rates after Craigslist's entry. The impact of Craigslist's entry on the classified-ad side appears to propagate to other sides of the newspapers' market. On the subscriber side, these newspapers experience an increase in subscription prices, a decrease in circulation, and an increase in differentiation from each other. On the display-ad side, affected newspapers experience a decrease in display-ad rates. We also find evidence that affected newspapers are less likely to make their content available online. Finally, we estimate that Craigslist's entry leads to $5.0 billion (year 2000 dollars) in savings to classified-ad buyers during 2000–2007.

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1. Introduction

Many firms operate in industries that can be characterized as multi-sided, in which an incumbent interacts with two or more sides of the market. Examples include online auction sites (buyers and sellers), shopping malls (shoppers and stores), credit cards (card holders and merchants), ad-sponsored search engines (Web surfers and advertisers), smartphone systems (users and application developers), and media industries such as newspapers and television networks (content consumers and advertisers). In such a market, different sides are often interlinked. For example, in the case of smartphone operating systems, application developers may choose to support a system based on the installed base of the system and users may select a system based on the number of applications associated with the system. Similarly, in the case of ad-sponsored search engines, advertisers are more willing to advertise on a search engine with more users. This interdependency across different sides of a multi-sided market means that firm strategies on multiple sides are also interlinked. In particular, changes in market conditions on one side of a firm's market may require changes in strategies on the same side as well as on other sides of its market.

In this paper, we seek to understand how firms respond to entry in such markets. We study the impact of Craigslist, a website providing classified-advertising services, on local U.S. newspapers. Newspapers are platforms that link together three different sides of the market: subscribers, classified-ad buyers, and display-ad buyers.[1] Given the interdependencies across the three sides, a newspaper's business model comprises a set of strategies on all sides of its market. Craigslist is a disruptive competitor to newspapers' classified-ad business: it offers classified ads for free in most cases,[2] and ads on Craigslist are easy to search and update in real time, unlike a newspaper. We therefore expect Craigslist's entry to significantly reduce newspapers' attractiveness to classified-ad buyers. Moreover, given the interdependency across the three sides, we expect that Craigslist's entry also leads the newspaper to adjust its business model by changing its strategies on all sides of its market. We empirically document these changes and, where

[1] Businesses use display ads, which often contain graphics or other artwork, to promote their products and services; such ads are displayed alongside regular editorial content. In contrast, classified ads typically have no pictures or other graphics. They are grouped entirely in a distinct section. In the classified-ads section, ads are usually grouped under headings classifying the products or services, such as "automobiles," "for sale," and "for rent."

[2] Craigslist charges for job listings in a small number of cities and for apartment listings in New York City. *Source*: http://www.craigslist.org/about/factsheet, accessed May 2011.

appropriate, interpret these changes in light of existing theoretical predictions.

We identify local newspapers for which classified ads are likely to provide a significant fraction of revenue by whether or not they have a classified-ad manager. For newspapers without classified-ad managers, classified-ad revenue is likely not their major source of revenue. Even if Craigslist enters their markets, these newspapers are less likely to respond.[3] Hence, we consider newspapers that have classified-ad managers and are located in markets where Craigslist eventually enters as "affected" newspapers.[4] We consider all other newspapers, i.e., those newspapers that do not have classified-ad managers or are not located in markets where Craigslist eventually enters, as "control" newspapers.

We adopt a difference-in-differences approach that compares the affected newspapers before and after Craigslist's entry to the control newspapers. One of the strengths of this research design is that Craigslist entered different newspaper markets at different points in time. The geographic and temporal variation in entry allows us to tease out the effect of shocks to newspapers' classified-ad business from broader macro trends associated with diffusion of the Internet (e.g., Forman et al. 2012). Another strength of the research design is that Craigslist's entry into a market is arguably exogenous with respect to any anticipated response by newspapers. We provide anecdotal and empirical evidence to support this claim.

Following Craigslist's entry, we find that affected newspapers decrease their classified-ad rates more than control newspapers. This finding complements a finding in Kroft and Pope (2013) who show that Craigslist caused a reduction in the Conference Board's Help-Wanted Index, a measure of job classifieds in 51 major print newspapers. On the subscriber side, we find that affected newspapers *increase* subscription prices relative to control newspapers. Although consistent with theoretical work on two-sided markets (e.g., Godes et al. 2009, Hagiu 2009), this finding is in sharp contrast to those in many one-sided markets, where competition typically leads to a *decrease* in prices. We also find evidence that the circulation of affected newspapers decreases and content differentiation between newspapers increases following Craigslist's entry. On the display-ad side, we find that display-ad rates of affected newspapers decrease following Craigslist's entry. The timing of when these changes occur on each side of the newspaper market suggests that the effect of Craigslist's entry on the classified-ad side propagates first to the subscriber side and then to the display-ad side.

We provide two extensions to our main findings. First, we explore the extent to which Craigslist's entry affects newspapers' likelihood of offering online content. Although offering online content allows newspapers to retain their readers and generate additional revenue from selling ads online, it cannibalizes newspapers' offline business and renders affected newspapers' strategies to capture more value from print subscribers less effective. Consistent with this intuition, we find that these affected newspapers are less likely to make their content available online. Second, we investigate the financial impact of Craigslist's entry on classified-ad buyers. To do this, we gather additional data on classified-ad quantities for a subset of newspapers in our sample. We then use this data to estimate that Craigslist's entry lead to $5.0 billion in year 2000 dollars in savings to classified-ad buyers during the 2000–2007 period. Although data limitations prevent us from performing a complete welfare analysis, these results suggest that classified-ad buyers benefited at the expense of newspapers.

Our paper makes several important contributions. At a broad level, our paper examines the patterns of responses by incumbents to entrants in multi-sided market settings, an area of growing research interest. Many of the responses that we document, particularly on newspapers' pricing strategies, provide support for theoretical predictions from two-sided market literature. Whereas much of the existing theory focuses on pricing responses, we also study other response mechanisms, including differentiation and the decision to go online or stay offline. Our paper thus complements several recent studies examining how platforms use nonprice instruments to grow their businesses (e.g., Gawer and Cusumano 2002, Boudreau and Hagiu 2009, Casadesus-Masanell and Halaburda 2013). The patterns we document should be useful to other researchers attempting to understand how the interdependence across different sides of a multi-sided market affects incumbent firm responses to entry on one side. Finally, the context in which we study these issues, the impact of the Internet on the U.S. newspaper industry, is one that has received a great deal of attention (e.g., Athey et al. 2010). Our study helps to further our understanding of this phenomenon.

2. Related Literature

Our study builds off and contributes to several streams of research. First, we add to a nascent stream of research on multi-sided markets (e.g., Caillaud and Jullien 2003, Rochet and Tirole 2003, Parker and Van Alstyne 2005, Armstrong 2006, Hagiu 2006,

[3] Our empirical analysis serves as a test for this assumption. We find that indeed these newspapers without classified-ad managers are much less likely to respond to Craigslist's entry.

[4] In §5 we describe a number of robustness checks on our classification of "affected" newspapers.

Weyl 2010, Zhu and Iansiti 2012). Most of this literature focuses on markets with two sides.[5] One fundamental theoretical finding from the two-sided market setting is that cross-side network effects link a platform's price choices on the two. As a result, it is often profit maximizing for a platform to undercut its price below cost on one side of the market to attract more consumers on that side, thereby increasing the willingness to pay of consumers on the other side. The relative price elasticity on each side determines which side is subsidized. The interdependence of price choices on the two sides suggests that changes in market conditions (e.g., competition intensity) of one side of the market will affect not only the platform's price choice on that side but also its price choice on the other side.

Consistent with this intuition, a few theoretical studies show that an increase in competition on one side of a two-sided market can lead to an increase in price on the other side (Godes et al. 2009, Hagiu 2009). Anecdotal evidence also supports this theoretical finding. Most newspaper websites in the 1990s, for example, offered their content for free and financed themselves exclusively by advertising revenues. However, during the 2000s the number of online content sites increased, thereby increasing competition on the advertising side of the market. As a result, many newspaper websites, such as those for the *New York Times* and the *Los Angeles Times*, switched to subscription-based business models (Casadesus-Masanell and Zhu 2010).[6] The websites chose to increase prices on the reader side because competition for advertisers reduced the return per reader from the ad market, making them less willing to underprice content to increase readership.

A number of empirical studies have examined platforms' pricing decisions in two-sided markets. For example, Kaiser and Wright (2006) and Song (2011) show that in the magazine industry, prices for readers are subsidized and magazines make most of their money from advertisers. Argentesi and Filistrucchi (2007) find a similar pattern in the Italian newspaper industry. Wilbur (2008) finds that the price elasticity of advertising demand in the TV industry is substantially more elastic than it was 30 years ago, and Goettler (2012) finds that TV advertising prices depend on audience composition. In general, these studies find support for the skewed pricing structures on different sides of a two-sided market.

On the other hand, few empirical studies except Jin and Rysman (2012) provide direct tests of how changes in competition on one side of the market affect platform pricing on other sides.[7] Jin and Rysman (2012) study sportcards conventions and show that competition between conventions leads to lower prices for consumers but higher prices for dealers. The direction of price changes hinges on the relative intensity of competition on each side of the market. Jin and Rysman use variation in geographic distance between conventions to infer an asymmetric degree of competition for consumers and dealers.

Our empirical setting differs in several ways. First, Craigslist's entry directly affects only one side of the newspaper market because Craigslist provides classified ads and not editorial content. Hence our empirical analysis provides a sharp test of how increased competition on one side of the market affects other sides. Second, our study employs a difference-in-differences research design that uses panel data on newspapers together with Craigslist's temporal and geographic entry patterns. This research design helps rule out multiple alternative explanations. Third, empirical and anecdotal evidence suggests that Craigslist's entry is exogenous with respect to newspaper responses. Fourth, although much of the literature focuses on two-sided markets, many platforms often serve markets with more than two sides. Our paper is the first empirical paper that examines a market with more than two sides and investigates platform responses in all three sides. Our analysis shows that the direction of price change in a three-sided market depends on the interdependency across different sides. In our setting, the display-ad side does not interact directly with the classified-ad side; they are linked to each other through the subscriber side. Display-ad rates drop as an *indirect* result of increased competition on the classified-ad side. Finally, we show that the newspaper's response is not limited to pricing but also includes changes to content positioning vis-à-vis other newspapers.

Our study is also related to theoretical work examining platforms' positioning strategies in multi-sided markets (e.g., Gabszewicz et al. 2001, 2006; Peitz and

[5] Much of this literature studies competition between platforms (e.g., Casadesus-Masanell and Ghemawat 2006, Economides and Katsamaks 2006); the platform provider's decision about how much to open its platform to create a platform ecosystem (Boudreau and Lakhani 2009; Boudreau 2010, 2012; Ceccagnoli et al. 2012; Huang et al. 2013); and platform providers' optimal choices of business models (e.g., Chen et al. 2011).

[6] For other examples, see Tartakoff (2009) for a partial list of newspaper sites charging fees to readers.

[7] Much of the empirical literature on multi-sided markets focuses on quantifying indirect network effects in these markets (e.g., Nair et al. 2004, Kaiser and Song 2009, Wilbur 2008), evaluating exclusive contracting between platforms and application developers (e.g., Corts and Lederman 2009), and examining conditions under which tipping occurs (e.g., Cantillon and Yin 2008). Chandra and Collard-Wexler (2009) study changes to subscription prices following newspaper mergers. Their analysis focuses on changes in competition between platforms rather than changes in competition on one side of a platform's market.

Valletti 2008). These studies find that as advertisers' willingness to pay for each content reader increases, media platforms have incentives to lower prices and cater to the majority taste on the content reader side in an effort to sell "more eyeballs" to advertisers. In the extreme case where advertisers' willingness to pay is sufficiently high, platforms will provide identical content to cater to the majority taste, a phenomenon often referred to as the Principle of Duplication or the Principle of Minimum Differentiation (Anderson and Gabszewicz 2006, Sun and Zhu 2013). In contrast, when a market shock reduces demand from advertisers, media firms will differentiate from each other so that they can raise subscription prices to capture more value on the subscriber side.

Theoretical predictions on platforms' positioning strategies, however, have received little empirical evaluation. Unlike simple tactics such as pricing, repositioning requires new product design and skills at acquiring different types of customers. Because the theoretical literature does not explicitly incorporate these considerations, it is not clear whether firms will, in practice, reposition themselves in response to entry as predicted. Our results suggest that differentiation between newspapers increases following Craigslist's entry. To the best of our knowledge, our results provide the first empirical evidence consistent with these theoretical predictions on differentiation in multi-sided markets.

Existing empirical work on differentiation as a strategic response focuses on one-sided settings. In these settings, a firm enters a market and upsets the existing equilibrium between incumbent firms, causing incumbents to reposition themselves in response *to the entrant*. In some cases, incumbents will attempt to differentiate away from the entrant, particularly if the incumbent is a large or dominant firm (e.g., Semadeni 2006) or has a decided cost or quality advantage (e.g., McGahan and Ghemawat 1994, Prince and Simon 2010). In certain cases, however, the incumbents will move closer to the entrant (e.g., Thomas and Wiegelt 2000). Recent literature in this area attempts to discern conditions under which an incumbent will maintain its distance from or stay close to the entrant (e.g., de Figueiredo and Silverman 2007, Wang and Shaver 2013). A closely related subset of this literature studies how firms use product variety as a strategic response to entry (e.g., Olivares and Cachon 2009, Ren et al. 2011). We contribute to this stream of literature by studying incumbent product repositioning in a multi-sided market setting and by documenting that the repositioning occurs in tandem with other responses including price increases.

Finally, our study contributes to the literature that examines how the Internet affects firms and consumers in offline settings. At a broad level, a number of studies have argued that online intermediaries reduce buyer search costs, thereby improving the efficient matching of buyers and sellers (e.g., Bakos 1997, Kroft and Pope 2013). Studies in a variety of contexts have examined whether online and offline channels substitute or complement each other (e.g., Zentner 2006; Kaiser 2006; Gentzkow 2007; Simon and Kadiyali 2007; Forman et al. 2009; Danaher et al. 2010; Choi and Bell 2011; Goldfarb and Tucker 2011a, 2011b; Liebowitz and Zentner 2012). Studies have also shown that the reduction of search cost owing to the advent of online channels may reallocate market shares from high- to low-cost producers (Goldmanis et al. 2010). Our study complements these studies by examining how the diffusion of the Internet affects newspapers' pricing and content positioning decisions. Our finding that Craigslist leads to a significant reduction in newspapers' classified-ad rates suggests that Craigslist acts as a substitute for newspapers' classified services, and we calculate a lower bound for the savings gained by classified-ad buyers that switch to this substitute. In addition, we provide evidence that affected newspapers are less likely to make their content available online as a result of Craigslist's entry, suggesting that the impact of the Internet on offline firms goes beyond product pricing.

3. Empirical Setting

A key empirical challenge in examining the interdependence of platform strategies across different sides of its market is the identification of causal relationship: because different sides of the market are interlinked, it is difficult to identify the magnitude of effect in each direction. In addition, changes in competitive intensity in the market are endogenous in most cases (for example, the entry of a new platform could depend on its expectation of future market outcomes). We therefore need to rely on some shocks that exogenously change competition intensity on one side of the market to estimate the causal effect across different sides of the market.

To address these issues, we study the local U.S. newspaper industry during the 1997–2007 period. There are several features of this industry that make it an appealing empirical setting. First, the circulation for most local newspapers has limited geographic reach effectively segmenting the United States into hundreds of nonoverlapping geographic markets, which is useful from a research design point of view. Second, we are able to collect data on all three sides of the newspaper market. Typically, one of the empirical challenges associated with studying multi-sided markets is collecting data on all sides of the market. For example, video games are a canonical example of a two-sided market, but researchers do not observe the contractual agreements on royalty rates between console providers and game publishers.

Historically, revenues from classified ads accounted for 40% of a newspaper's total revenues on average (Vogel 2011). However, during the time period studied, the industry experienced a severe shock to its business model due to the rapid entry of Craigslist, a website specializing in online classified listings. Craigslist began in 1995 as an email distribution list of friends in the San Francisco Bay Area, before becoming a Web-based service in 1996. Craigslist expanded into 8 other U.S. markets in 2000, 4 in 2001 and 2002 each, 12 in 2003, and many more markets in recent years.[8] As of 2010, Craigslist is available for more than 700 local markets in 70 countries;[9] it serves more than 20 billion page views per month and is the seventh most-visited website in the United States.[10] With more than 50 million new classified advertisements each month,[11] as well as about 60 million unique visitors in the United States each month,[12] Craigslist is the leading classified-ad service in any medium.

The expansion of Craigslist into a newspaper's local market has the potential to be incredibly disruptive, leading to an almost immediate drop in a large portion of classified-ad revenue. Indeed, Craigslist has been criticized for stealing a massive chunk of the classified market from established local newspapers and is frequently referred as a "newspaper killer."[13] Craigslist's entry into different markets has been linked to other outcomes, including an increase in sexually transmitted diseases (Chan and Ghose 2013), a reduction in real estate vacancy rates (Kroft and Pope 2013), and a reduction in the number of negative financial words in local newspapers about local companies (Gurun and Butler 2012).

Craigslist provides only classified-ad listings, not editorial content or display ads. We therefore operate under the assumption that the main effect of Craigslist entry is on the classified-ad side of the newspaper's market and that any effects on the subscriber or display-ad side are secondary effects. As such, the empirical setting closely matches the conditions described in theoretical work that studies how an increase in competition on one side of the market may affect strategic choices on other sides.

The temporal and geographic variation in Craigslist's expansion into different markets allows us to establish a causal relationship and rule out alternative explanations. For example, websites such as eBay.com, an online auction site, and Monster.com, a job-listing website, also attract classified advertisers away from newspapers, and content sites, such as blogs and Google news, attract newspaper readers away from newspapers. However, unlike Craigslist, these sites contemporaneously serve consumers in all regions in the United States. In our setting, temporal and geographical variation in entry allow us to use year dummies interacted with newspaper types to control for the overall effects these types of websites have on newspapers as well as the disproportionate effects these websites have on different types of newspapers.

Finally, Craigslist's product is similar across markets in a given year, making it easy to compare entry events. The Craigslist webpage for Boston in February 2003, for example, is nearly identical to that for Chicago in February 2003.[14] One noticeable difference across these webpages is the number of posts in each category, perhaps indicating heterogeneity in Craigslist's diffusion across markets. In the results section below, we show that our findings are robust to controlling for these cross-market differences.

4. Data and Summary Statistics

4.1. Dependent Variables

We collect data from several sources. Information on classified-ad rates is from the *SRDS Newspaper Advertising Source* (SRDS) for years 1999–2006. SRDS has been used in other media studies (e.g., Ekelund et al. 2000). Information on each newspaper's yearly subscription price, circulation, display-ad rate, and editor type is from *Editor & Publisher International Yearbooks* (E&P) for years 1997, 1998, 2000, 2002–2005, and 2007. The yearbooks contain data on virtually every newspaper in the United States and have been used extensively for newspaper studies (e.g., George and Waldfogel 2006, Chandra 2009, Gentzkow and Shapiro 2010). We focus on newspapers that have a predominantly local focus and therefore exclude large national papers, including the *Wall Street Journal*, *New York Times*, and *USA Today*, from all our analyses.

We construct our differentiation measure by combining data from E&P and zip-code circulation data for 2000–2007 from the *Audit Bureau of Circulations* (ABC), a leading auditor of periodical information in the United States and many other countries. We first use data on editor types from E&P to determine the type of news content offered by each newspaper. Consistent with George and Waldfogel (2003), we assume

[8] http://www.craigslist.org/about/expansion, accessed July 2010.

[9] http://www.craigslist.org/about/factsheet, accessed July 2010.

[10] http://www.alexa.com/siteinfo/craigslist.org, accessed July 2010.

[11] http://www.craigslist.org/about/factsheet, accessed July 2010.

[12] http://siteanalytics.compete.com/craigslist.org/, accessed July 2010.

[13] For examples, see http://bit.ly/LzcNFZ, http://bit.ly/RSl6e, http://bit.ly/L1La1Q, and http://onforb.es/rQ3XS, accessed July 2011.

[14] Historical screen shots of Craigslist are available via InternetArchive.org. For examples, see historical Boston and Chicago sites http://web.archive.org/web/20030129082927/boston.craigslist.org/ and http://web.archive.org/web/20030205062029/http://chicago.craigslist.org/, accessed June 2012.

that a newspaper's content is positively correlated with its editor types.[15] We categorize each editor's title for each newspaper i in year t into one of the following 11 topical types: art, business, entertainment, home, local/regional, national/foreign, special topics, sports, style/lifestyle, technology, and travel. We use these topical types to construct a vector V_{it} with 11 elements to indicate whether the newspaper has an editor for each of the 11 topical types.

We then use circulation data to identify the set of newspapers, C_i, with which newspaper i competes. ABC does not collect circulation data for low-circulation, small-town newspapers, so we supplement the ABC data with data from E&P and assume that these small newspapers circulate only in the cities where they are based.[16] Following Sweeting (2010) and Wang and Shaver (2013), we compute the initial differentiation (in editor-type space) between newspaper i and its competitor j, $j \in C_i$, in year t by locating the two newspapers in the product space using V_{it} and V_{jt} and measuring the angle distance (in radians) between their product location vectors (normalized by $\pi/2$):

$$Differentiation_{ij,t} = \left(\cos^{-1}\frac{V_{it}\cdot V_{jt}}{\|V_{it}\|\|V_{jt}\|}\right)\Big/\left(\frac{\pi}{2}\right).$$

This initial differentiation measure ranges from 0 to 1. The greater its value, the more differentiated are the two newspapers. In particular, when the differentiation measure is 0, the two newspapers have identical sets of editors (minimum differentiation). When the differentiation measure is 1, there is no overlap between the editor types at the two newspapers (maximum differentiation). Prior research shows that firms of a similar type compete more intensely than do firms of different types (e.g., Chiou 2009). Hence, one would expect a newspaper to care most about the competitor whose product portfolio is located "closest" to it in product space. Based on this intuition, we create a differentiation measure for each newspaper i by taking the minimum of all differentiation between newspaper i and its competitors:

$$Differentiation_{it} = \min_{j\in C_i}\{Differentiation_{ij,t}\}.$$

[15] To further justify our use of editor positions to proxy for the content produced by the newspaper, we use NewsLibrary.com to collect information on the number of articles of different content types in each newspaper for the set of newspapers that appear in both NewsLibrary.com and our data set. We are able to match 257 newspapers in NewsLibrary.com to our data set for the year 2000. We identify content produced by each of these newspapers by searching NewsLibrary.com for articles with the following words: art, business, entertainment, international, sports, style, and technology. We find a high correlation between editor type and article content. Other research, such as Gentzkow and Shapiro (2010), also relies on NewsLibrary.com for news-content analysis.

[16] E&P provides only aggregate circulation data for each newspaper.

$Differentiation_{it}$ measures the distance between newspaper i and its most-similar competitor at time t. In robustness checks, we show that our findings are robust to another measure of differentiation that measures the distance between newspaper i and its most-significant competitor at time t.

4.2. Independent Variables

The dummy variable $Craigslist\ entry_{it}$ equals 1 for all years after Craigslist enters newspaper i's local market and 0 otherwise. Information on the date of Craigslist's entry into different markets is from Craigslist.org. We define the relevant market to be the county in which the newspaper is based, an approach consistent with other research in this area (e.g., Gentzkow and Shapiro 2010) and consistent with Craigslist's product offerings, which often vary by county or state region.[17] For example, Craigslist has separate pages for La Salle County, Illinois; Fairfield County, Connecticut; Western Maryland; and Eastern North Carolina, to name a few. During the time period we study, Craigslist enters 308 markets.[18]

We use InternetArchive.org to access historical pages of Craigslist for each year for all of the markets in our sample, and from these pages we gather counts of the number of posts in each category. For example, in Boston on February 7, 2003, under the category "sale/wanted," there were 2,725 posts listed under "general for sale" and 730 posts listed under "items wanted."[19] These category counts are then aggregated up to the market level to create a variable $number\ of\ posts_{it}$, which we use in the robustness checks instead of $Craigslist\ entry_{it}$. Over the years, Craigslist has added new categories, such as personals. To ensure that we can compare the number of posts on Craigslist in different years, we only aggregate counts in four categories (community, housing, jobs, and sales/wanted) that Craigslist has had since its inception. When InternetArchive.org archives the same webpage multiple times in a single year, we take the average of these counts in each year.

We construct the variable $classified_{it}$ from a field in E&P that lists positions in the advertising-sales management team. If one or more positions include the word "classified," we code $classified_{it}$ as one; otherwise we code it as 0.[20] We use this variable to indicate

[17] The relevant newspaper market has been alternatively defined at other levels including the zip code (Chandra 2009) and metropolitan statistical area (George and Waldfogel 2006).

[18] The company lists the dates and locations of its expansion here: http://www.craigslist.org/about/expansion.

[19] http://web.archive.org/web/20030129082927/boston.craigslist.org/, last accessed June 2012.

[20] Examples of other position titles include advertising department manager, advertising sales director, retail sales manager, advertising coordinator for special sections, and advertising manager for major accounts.

those newspapers that rely heavily on classified ads, and hence we expect those newspapers to be significantly affected by Craigslist's entry. Thirty-four percent of newspapers have a classified-ad manager.

4.3. Control Variables

We use E&P to construct a number of newspaper-specific control variables. The dummy variable $independent_i$ equals 1 if the newspaper's self-declared political affiliation in 2005 is independent and 0 otherwise.[21] Similar to Goh et al. (2011), we find that although many newspapers exhibit political leaning, 92% of newspapers declare themselves to be "independent." The continuous variable $newspaper\ age_{it}$ is the difference between the year in the sample and the year the newspaper was founded. We also categorize each content editor's title into one of the following types: art, business, entertainment, home, local, national, opinion, special, sports, and technology. To measure newspapers' content variety, we construct a variable $total\ positions_{it}$, which is the total number of editor types at a newspaper. We also construct a dummy variable, $online\ editor_{it}$, which indicates whether newspaper i has an editor for online content in year t. About 20% of newspapers in our sample have an online editor. Finally, we construct a dummy variable, $MIS\ manager_{it}$, which indicates whether newspaper i has a management information systems (MIS) manager position in year t. Fifty-six percent of newspapers in our sample have an MIS manager.

We collect county level demographic data on age_i, $population_i$, $pct\ college\ degree_i$, $per\ capita\ income_i$, and $pct\ renters_i$ for the year 2000 from the U.S. Census Bureau.[22] Following George and Waldfogel (2006), we use population data as a denominator to transform the circulation variable into circulation share and use it as one of our dependent variables.[23] We also collect information on the number of high-speed Internet service providers (ISPs) at the zip code for 2000–2007 from the Federal Communications Commission (FCC).[24] This information is then averaged across all zip codes in the county and divided by county population to transform the number of ISPs in the county into the variable $average\ ISPs_{it}$. Wallsten and Mallahan (2010) show that the number of ISPs in a market is positively correlated with broadband quality and negatively correlated with broadband price. Hence, this variable is used to control for diffusion of the Internet within the relevant market, which may affect newspaper strategies.

[21] We construct this variable using data from 2005 only. There is no evidence that a newspaper's political leaning changes over our time period.

[22] Available for download from the U.S. Census Bureau at http://factfinder.census.gov, last accessed May 2011.

[23] Our results remain qualitatively unchanged when we use the logarithm of circulation as the dependent variable.

[24] Available for download from the FCC at http://www.fcc.gov/wcb/iatd/comp.html, last accessed May 2011.

4.4. Summary Statistics

Table 1 reports summary statistics of all variables, as well as split sample statistics based on whether or not Craigslist enters the newspaper's market. The t-tests reveal differences for most of the variables across the split samples. These results suggest that it is important to control for newspaper fixed effects in our analysis so that we can focus on the change in these variables. We also undertake a number of robustness tests, described below, to ensure that our results are not driven by observable or unobservable differences across these samples.

Table 2 provides additional summary statistics for classified-ad rates, subscription prices, circulation shares, differentiation, and display-ad rates before and after Craigslist's entry, broken out separately for newspapers with and without a classified-ad manager. There is substantial variation across newspapers for each of these five measures (see Table 1), which is addressed using newspaper fixed effects in the econometric models discussed below. To address this heterogeneity in Table 2, we standardize these measures (to measures with mean 0 and standard deviation 1) for each newspaper before computing averages. We compute the summary statistics for newspapers with and without a classified-ad manager in the year of Craigslist's entry separately. We find classified-ad rates, subscription prices, differentiation, and display-ad rates increase for newspapers over time, but circulation shares decrease over time. We also compute the changes for newspapers before and after Craigslist's entry and compare newspapers with classified-ad managers in Craigslist's entry year to those without. We find that those newspapers that are more likely to be affected by Craigslist's entry have greater decreases in classified-ad rates, circulation shares, and display-ad rates and greater increases in subscription prices and differentiation. One-tailed t-tests show these differences are significant for all measures except display-ad rates.

5. Empirical Results

5.1. Main Results

Our empirical design relies on a difference-in-differences approach for each dependent variable that compares the variable after Craigslist's entry to the variable before Craigslist's entry for affected and control newspapers. The specification is of the following form:

$$\begin{aligned} &dependent\ variable_{it} \\ &= \beta_0 + \beta_1 Craigslist\ entry_{it} + \beta_2 Craigslist\ entry_{it} * classified_{it} \\ &\quad + \beta_3 classified_{it} + X_{it}B + \gamma_i + \eta_t + \varepsilon_{it}, \end{aligned} \tag{1}$$

Table 1 Summary Statistics

Variable	All observations				Craigslist not entered		Craigslist entered		Mean difference	Data source
	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Mean	Std. dev.		
Craigslist entry	0.04	0.19	0.00	1.00	0.00	0.00	0.32	0.47	−0.32***	Craigslist.org
Classified rate	5.55	6.31	0.11	143.00	4.83	5.55	6.11	6.77	−1.28***	SRDS
Subscription price	121.67	44.34	11.05	443.04	112.31	38.16	139.68	49.56	−27.37***	E&P
Circulation share	0.18	0.12	0.00	0.88	0.18	0.12	0.18	0.12	0.00	E&P
Differentiation	0.45	0.20	0.00	1.00	0.49	0.20	0.41	0.20	0.08***	E&P
Display-ad rate	53.13	100.58	3.70	3,221.86	28.98	41.34	88.68	142.76	−59.69***	E&P
Classified-ad manager	0.34	0.47	0.00	1.00	0.28	0.45	0.45	0.50	−0.16***	E&P
Independent	0.92	0.27	0.00	1.00	0.90	0.30	0.95	0.23	−0.05***	E&P
Year founded	1,886.15	36.03	1,764.00	2,006.00	1,886.73	33.99	1,885.11	39.45	1.61*	E&P
Online editor	0.20	0.40	0.00	1.00	0.19	0.39	0.23	0.42	−0.04***	E&P
MIS manager	0.56	0.50	0.00	1.00	0.50	0.50	0.68	0.47	−0.18***	E&P
Total positions	5.17	3.15	1.00	14.00	4.66	3.00	6.15	3.18	−1.48***	E&P
Average ISPs	6.00	3.26	0.00	18.56	5.48	3.03	6.96	3.44	−1.49***	FCC
Number of posts	939.23	9,278.01	0.00	295,932.00	2.59	87.81	8,343.59	26,551.43	−8,341.00***	InternetArchive.org
Age (county)	37.09	2.76	23.30	54.30	37.48	2.58	36.37	2.92	1.11***	Census
Population (county)	361,240.60	1,061,571.00	2,681.00	9,891,484.00	154,840.26	333,656.63	739,120.05	1,663,177.30	−584,279.79***	Census
Pct. college degree (county)	0.13	0.05	0.03	0.40	0.12	0.04	0.16	0.06	−0.04***	Census
Per capita income (county)	19,481.77	4,497.84	9,872.00	44,962.00	18,680.40	4,056.58	20,948.93	4,880.60	−2,268.53***	Census
Pct. rental (county)	0.30	0.08	0.12	0.80	0.28	0.06	0.35	0.09	−0.07***	Census

Note. In the second to last column, we take the difference between the means for the markets that Craigslist enters and does not enter during our study period.
*Significant at 10%; ***significant at 1%.

Table 2 Comparison of Newspaper Responses Before and After Craigslist's Entry

	With classified-ad manager in entry year		Without classified-ad manager in entry year		
	Pre-entry	Post-entry	Pre-entry	Post-entry	Difference in differences
Classified-ad rate	−0.24	0.68	−0.44	0.90	−0.42***
Subscription price	−0.27	0.86	−0.22	0.66	0.25**
Circulation share	0.41	−1.02	0.28	−0.95	−0.20**
Differentiation	−0.06	0.32	−0.03	0.14	0.21**
Display-ad rate	−0.37	0.92	−0.33	1.04	−0.08

Note. In the last column, we take the difference between postentry value and preentry value for newspapers with a classified-ad manager in Craigslist's entry year and compare it to the difference for those without a classified-ad manager in Craigslist's entry year.
**significant at 5%; ***significant at 1%.

where $dependent\ variable_{it}$ is one of five dependent variables described above, X_{it} is a vector of market control variables, γ_i is a newspaper fixed effect, and η_t is a year fixed effect. Inclusion of the newspaper fixed effect controls for any fixed differences across newspapers, and the year dummies control for common macroeconomic shocks that affect all newspapers. Some macroeconomic shocks (e.g., the diffusion of Monster.com, a job-listing website) may differentially affect newspapers with different degrees of reliance on classified-ad business. We therefore include interactions between $classified_{it}$ and year dummies in X_{it}. These interaction variables also help control for any preexisting trends. We also include a count of the number of Internet service providers in the market, $average\ ISPs_{it}$, in X_{it} to address changes in the relative ease of Internet access, which might affect a local newspaper's classified-ad business. We cluster the error terms at the level of the newspaper to account for autocorrelation in the data within newspapers and over time (Bertrand et al. 2004).

Models 1 and 2 of Table 3 report regression results on $classified\text{-}ad\ rate_{it}$. All models include newspaper and year fixed effects. Model 1 replicates Equation (1). Model 2 replicates Model 1 and includes $average\ ISPs_{it}$; there are fewer observations because $average\ ISPs_{it}$ is only available after 1999.[25] The coefficients

[25] Because our data on classified-ad rates are from 1999 to 2006 and we miss data on classified-ad managers in 2001 and 2006, the years used in the regression are 1999, 2000, and 2002–2005 when average number of ISPs are not included as a control and 2000 and 2002–2005 when average number of ISPs are included as a control. Similarly, when subscription prices, circulation shares, and display-ad rates are dependent variables, the years used in the analysis are 1997, 1998, 2000, 2002, 2003, 2005, and 2007 when average number of ISPs are not included as a control and 2000, 2002–2005, and 2007

Table 3 Effect of Craigslist Entry on Newspaper Classified-Ad Rates and Propagation to Other Sides of Market (OLS Models)

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Log *classified-ad rate*		Log *price*		*Circulation share*		*Differentiation*		Log *display-ad rate*	
Craigslist entry	0.089	0.068	−0.020**	−0.013	0.002	0.000	−0.036	−0.032	0.022*	0.011
	[0.077]	[0.071]	[0.009]	[0.008]	[0.002]	[0.001]	[0.022]	[0.022]	[0.013]	[0.012]
Classified	−0.005	0.028	−0.016	−0.026***	−0.001	−0.002	−0.007	−0.008	0.006	0.016
	[0.047]	[0.051]	[0.009]	[0.010]	[0.002]	[0.002]	[0.013]	[0.013]	[0.012]	[0.013]
Craigslist entry ∗ *Classified*	−0.230**	−0.207**	0.026**	0.033***	−0.008**	−0.006**	0.074***	0.074***	−0.009	−0.031**
	[0.092]	[0.091]	[0.012]	[0.011]	[0.003]	[0.003]	[0.023]	[0.023]	[0.016]	[0.015]
Average ISPs		−0.398		0.072**		−0.043**		0.209*		−0.126**
		[0.247]		[0.034]		[0.019]		[0.107]		[0.053]
Newspaper fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Classified ∗ Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,674	4,098	8,937	6,802	5,938	4,427	4,194	4,194	6,460	4,918
Number of newspaper IDs	1,038	1,000	2,086	1,961	1,576	1,454	917	917	1,617	1,500
Adjusted *R*-squared	0.182	0.132	0.131	0.113	0.226	0.256	0.026	0.027	0.471	0.328

Notes. This table reports OLS results from regressions on log classified-ad rate, log price, circulation share, differentiation, and log display-ad rate. Data are from 1999–2007 in Models 1, 3, 5, and 9 and from 2000–2007 in Models 2, 4, 6, and 10 because of data availability for the *average ISPs* variable. Data are from 2000–2007 in Models 7 and 8 because of data availability. See Footnote 25 for additional information on years of data availability. *Craigslist entry* is a dummy variable that equals 1 for all years after Craigslist enters the county in which the newspaper is based and 0 otherwise. *Classified* is a dummy variable that equals 1 if the newspaper lists a classified-ad manager in that year and 0 otherwise. *Average ISPs* is the average number of ISPs across all zip codes in the county in which the newspaper is located. Heteroskedasticity-adjusted standard errors, clustered at the newspaper level, are included in square brackets.

*Significant at 10%; **significant at 5%; ***significant at 1%.

on $Craigslist\ entry_{it} * classified_{it}$ are negative and significant in both models. The results across models are similar; namely, relative to control newspapers, newspapers with classified-ad managers are more likely to lower classified-ad rates (by about 20.7%, on average, based on Model 2) following entry by Craigslist.

We next investigate how the effect of Craigslist's entry propagates to the subscriber side and the display-ad side. This analysis is accomplished by replacing classified-ad rate as the dependent variable in Equation (1) with subscription price, circulation share, differentiation, and display-ad rate, respectively. We replicate Models 1 and 2 (i.e., with and without $average\ ISPs_{it}$, respectively) for each of these dependent variables. We find that the coefficient on $classified_{it} * Craigslist\ entry_{it}$ is significant in all cases except Model 9, suggesting that Craigslist's entry into the newspaper's classified-ad side does influence the newspaper's subscriber side and display-ad side. In particular, we find that, relative to control newspapers, subscription prices of the affected newspapers increase by 3.3%, yearly circulation drops by 4.4%, differentiation increases by 16.5%, and display-ad rates drop by 3.1% (based on Models 4, 6, 8, and 10, respectively). It is worth noting that the magnitudes of the effects on the other sides are small relative to the effects on the classified-ad side. These results accord well with the idea that the direct effect of Craigslist's entry is to the newspaper's classified-ad business and that Craigslist's entry has an indirect effect on the other sides of the market.

To further examine any propagation effect of Craigslist's entry from the classified-ad side to the other sides, we next run a series of regressions that replace $Craigslist\ entry_{it}$ with dummy variables, $Craigslist\ entry^{s}_{it}$, where $s \in \{-3^{+}, -2, -1, 0, 1, 2, 3^{+}\}$, indicating whether year t is the sth year since Craigslist's entry in newspaper i's market. The omitted category from these regressions is the year of Craigslist's entry ($Craigslist\ entry^{0}_{it}$), in which we also group those newspapers that never experience entry by Craigslist. The results are presented in Table 4. The coefficients of interest are those on the interactions between $classified_{it}$ and $Craigslist\ entry^{s}_{it}$. The results for values of $s > 0$ show immediate impact of Craigslist's entry on classified-ad rate. For subscription price, circulation share, and differentiation, the effects show up in the year following Craigslist's entry. The effect on the display-ad side, however, remains small and insignificant until the third year following Craigslist's entry. Taken together, these results provide suggestive evidence that the direct effect of Craigslist's entry is to the newspaper's classified-ad business and that it takes time for the effect to propagate to the other sides of the market. Importantly, the results for values of $s < 0$ show no effect in the years leading up to Craigslist's entry. This provides suggestive evidence on the exogeneity of Craigslist entry with respect to newspaper outcomes,

when average number of ISPs are included as a control. For differentiation, the years included are 2000, 2002–2005, and 2007 because ABC only provides data starting from 2000.

Table 4 Effect of Craigslist Entry, Three-Year Leads and Lags (OLS Models)

Model	(1)	(2)	(3)	(4)	(5)
Dependent variable	Log *classified-ad rate*	Log *price*	*Circulation share*	*Differentiation*	Log *display-ad rate*
Craigslist entry$_{-3}$	−0.022	−0.015	−0.001	0.011	−0.003
	[0.059]	[0.012]	[0.002]	[0.020]	[0.017]
Craigslist entry$_{-2}$	−0.024	−0.008	0.000	0.024	0.003
	[0.049]	[0.011]	[0.003]	[0.022]	[0.014]
Craigslist entry$_{-1}$	−0.003	−0.010	−0.002	0.005	−0.019
	[0.043]	[0.008]	[0.002]	[0.017]	[0.012]
Craigslist entry$_{1}$	0.059	−0.002	−0.003*	0.012	0.013
	[0.058]	[0.012]	[0.001]	[0.026]	[0.020]
Craigslist entry$_{2}$	0.060	−0.020**	0.001	−0.044	0.005
	[0.093]	[0.008]	[0.001]	[0.030]	[0.016]
Craigslist entry$_{3}$	0.115	−0.013	−0.002	−0.029	0.021
	[0.166]	[0.013]	[0.002]	[0.032]	[0.017]
Classified	0.019	−0.040**	−0.001	−0.007	0.012
	[0.056]	[0.016]	[0.001]	[0.014]	[0.015]
Craigslist entry$_{-3}$ ∗ *Classified*	0.055	0.020	0.000	0.016	0.021
	[0.070]	[0.013]	[0.003]	[0.022]	[0.020]
Craigslist entry$_{-2}$ ∗ *Classified*	0.082	0.015	0.000	−0.021	−0.007
	[0.054]	[0.013]	[0.003]	[0.024]	[0.019]
Craigslist entry$_{-1}$ ∗ *Classified*	0.040	0.001	0.000	0.001	0.007
	[0.058]	[0.012]	[0.003]	[0.016]	[0.015]
Craigslist entry$_{1}$ ∗ *Classified*	−0.125*	0.026	−0.002	0.037	−0.015
	[0.074]	[0.019]	[0.003]	[0.026]	[0.023]
Craigslist entry$_{2}$ ∗ *Classified*	−0.241**	0.057***	−0.006***	0.075**	−0.021
	[0.121]	[0.015]	[0.002]	[0.035]	[0.020]
Craigslist entry$_{3}$ ∗ *Classified*	−0.383*	0.038*	−0.009*	0.056*	−0.061***
	[0.211]	[0.022]	[0.005]	[0.031]	[0.023]
Average ISPs	−0.307	0.085**	−0.041**	0.189*	−0.128**
	[0.286]	[0.038]	[0.020]	[0.104]	[0.054]
Newspaper fixed effects	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
Classified ∗ Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	4,098	6,802	4,427	4,194	4,918
Number of newspaper IDs	1,000	1,961	1,454	917	1,500
Adjusted R-squared	0.131	0.116	0.252	0.027	0.330

Notes. This table reports OLS results from regressions of log classified ad rate, log price, circulation share, differentiation, and log display-ad rate on three-year leads and lags of *Craigslist entry* along with an interaction between the leads and lags and *classified*, a dummy variable that equals 1 if the newspaper lists a classified-ad manager in that year and 0 otherwise. Year of Craigslist entry (i.e., *Craigslist entry*$_0$) is the omitted category; newspapers that do not experience Craigslist entry are categorized as *Craigslist entry*$_0$. Observations with greater than three-year lead are grouped with the three-year lead dummy, observations with greater than three-year lag are grouped with the three-year lag dummy. *Average ISPs* is the average number of ISPs across all zip codes in the county in which the newspaper is located. Heteroskedasticity-adjusted standard errors, clustered at the newspaper level, are included in square brackets.

*Significant at 10%; **significant at 5%; ***significant at 1%.

a topic that we explore in more detail in the next subsection.[26]

5.2. Robustness Checks

This subsection outlines several potential concerns with our results and the robustness tests undertaken to address each concern. The first concern we address is the potential endogeneity of Craigslist's entry. The ideal experiment in our setting would provide an exogenous shock randomly to some newspapers and not to other newspapers. Although our research design, which exploits temporal and geographical variation in Craigslist's entry into newspaper markets, does not exactly replicate the ideal experiment, we believe it provides a close approximation. Although our fixed-effects specifications control for time-invariant unobservables specific to newspapers and locations, it is still possible that Craigslist's entry decisions may be correlated with some time-varying unobservables. We undertake several tests to address this concern and rule out alternative explanations.

[26] The results for values of $s < 0$ also suggest that newspapers are not using pricing or other mechanisms in an attempt to deter entry (e.g., Prince and Simon 2010, Seamans 2013).

First, we take advantage of temporal and geographical variation in Craigslist's entry to directly examine which factors influence Craigslist's entry decisions. The idea is that if these time-varying location-specific unobservables affect both Craigslist's entry decisions and newspapers' characteristics, we should observe correlation between Craigslist's entry decisions and newspaper's characteristics. Table 5 presents the results of discrete-time hazard models that predict Craigslist's entry into a newspaper's market m as a function of market level demographics and newspaper characteristics. Craigslist's entry is an absorbing state, so we model the entry as a discrete hazard probability that market m will experience entry at time t given that it has not already experienced entry: $\Pr(\textit{Craigslist entry}_{mt} > 0 \mid \textit{Craigslist entry}_{mt-k} < 0)$ for some $k > 0$. In practice this amounts to running logit models that predict Craigslist's entry in a market m and dropping market m from the sample in years after it has experienced entry. To create market level newspaper characteristics, we take a simple average of newspaper level characteristics across all the newspapers in the market. Model 1 of Table 5 includes market level variables such as $\textit{age}_m$, $\textit{population}_m$, $\textit{pct college degree}_m$, $\textit{pct black}_m$, $\textit{per capita income}_m$, $\textit{pct renters}_m$, and $\textit{average ISPs}_{mt}$. Model 2 adds in additional characteristics including $\textit{number of newspapers}_{mt}$ in the market, $\textit{independent}_m$, and $\textit{newspaper age}_{mt}$. Finally, Model 3 adds in characteristics including $\textit{classified}_{mt}$, $\textit{number MIS positions}_{mt}$, and $\textit{total number of positions}_{mt}$. We find that $\textit{population}_m$, $\textit{pct college degree}_m$, $\textit{pct renters}_m$, and $\textit{average ISPs}_{mt}$ are significant predictors of Craigslist's entry, and these factors are controlled in the foregoing analyses by the use of fixed effects and inclusion of $\textit{average ISPs}_{it}$. The results of Table 5 therefore provide us with some confidence that Craigslist's entry decisions are not based on newspaper characteristics, particularly those that vary over time.

Second, we conduct a falsification test using Craigslist's entry patterns to examine the role of location-specific unobservables. We compare outcomes for affected newspapers to those of control newspapers prior to Craigslist's entry into their markets. If our assumption of the orthogonality between Craigslist's entry and time-varying local unobservables is violated in our fixed-effects specifications, our data will produce false positive associations between Craigslist's entry and the pricing strategies of these affected newspapers in periods prior to Craigslist's entry in their markets. To check this, we first create a new variable, $\textit{eventual entry}_i$, which is 1 if Craigslist enters location i at any time before 2007 and 0 otherwise. We then repeat our difference-in-differences analysis by replacing $\textit{Craigslist entry}_{it}$ with $\textit{eventual entry}_i$ and only analyzing observations for which $\textit{Craigslist entry}_{it}$ is 0. The effect of $\textit{eventual entry}_i$ is absorbed by the newspaper fixed effects. As reported in Models 1–5 of Table 6, we find that there is no significant correlation between each of the five outcome variables, $\textit{classified ad rate}_{it}$, $\textit{subscription price}_{it}$, $\textit{circulation share}_{it}$, $\textit{display ad rate}_{it}$, and $\textit{differentiation}_{it}$, and the interaction between $\textit{eventual entry}_i$ and $\textit{classified}_{it}$ during periods prior to Craigslist's entry. The absence of such false positives further increases our confidence in the exogeneity assumption.

This analysis above, however, only examines the average differences between affected newspapers and control newspapers prior to Craigslist's entry. It is still possible that two groups exhibit different trends

Table 5 Determinants of Craigslist Entry (Hazard Model; Marginal Effects Reported)

Model	(1)	(2)	(3)
Age	0.001	0.001	0.001
	[0.001]	[0.001]	[0.000]
Population	0.001***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]
Pct. college degree	0.155**	0.152**	0.128**
	[0.071]	[0.068]	[0.056]
Pct. black	−0.008	−0.008	−0.010
	[0.011]	[0.010]	[0.010]
Per capita income	−0.066	−0.064	−0.059
	[0.047]	[0.045]	[0.039]
Pct. rental	0.092**	0.091**	0.078**
	[0.041]	[0.041]	[0.035]
Average ISPs	−0.068*	−0.067*	−0.048*
	[0.038]	[0.037]	[0.027]
Number of papers		−0.000	−0.000
		[0.001]	[0.001]
Independent		0.005	0.005
		[0.004]	[0.004]
Newspaper age		−0.000	−0.000
		[0.000]	[0.000]
Classified			0.001
			[0.002]
Online editor			−0.004
			[0.003]
MIS manager			0.004
			[0.002]
Total positions			0.002
			[0.001]
Year dummies	Yes	Yes	Yes
Observations	4,155	4,155	4,155
Pseudo *R*-squared	0.533	0.534	0.543

Notes. This table reports results from a hazard model predicting Craigslist's entry into a county. The dependent variable equals 1 when the county experiences Craigslist's entry and 0 otherwise. Craigslist's entry is an absorbing state, so the county is dropped from the sample in the years after the dependent variable becomes 1. The controls include demographic variables at the county level and newspaper characteristics that have been averaged across all the newspapers in the county. Heteroskedasticity-adjusted standard errors are included in square brackets.

*Significant at 10%; **significant at 5%; ***significant at 1%.

Table 6 Falsification Check: Difference Between Affected Newspapers and Control Newspapers Before Craigslist's Entry (OLS Models)

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Log *classified-ad rate*	Log *price*	*Circulation share*	*Differentiation*	Log *display-ad rate*	Log *classified-ad rate*	Log *price*	*Circulation share*	*Differentiation*	Log *display-ad rate*
Classified	0.019	−0.034***	−0.001	−0.013	0.010	0.017	0.000	0.004*	−0.014	−0.019
	[0.054]	[0.011]	[0.002]	[0.014]	[0.016]	[0.039]	[0.009]	[0.002]	[0.014]	[0.018]
Eventual entry ∗ *Classified*	0.005	0.015	−0.003	0.007	0.018	−0.038	0.015	−0.004	0.010	0.035
	[0.062]	[0.011]	[0.003]	[0.017]	[0.018]	[0.065]	[0.013]	[0.005]	[0.020]	[0.022]
Average ISPs	−0.414*	0.061*	−0.037*	0.159	−0.080	−0.046	0.067*	−0.037**	0.159	−0.086
	[0.248]	[0.036]	[0.019]	[0.115]	[0.059]	[0.305]	[0.036]	[0.019]	[0.115]	[0.060]
Year 2002 ∗ *Eventual entry* ∗ *Classified*						−0.003	−0.004	0.001	0.015	−0.033
						[0.062]	[0.009]	[0.003]	[0.019]	[0.022]
Year 2003 ∗ *Eventual entry* ∗ *Classified*						−0.007	0.006	0.003	−0.016	−0.035
						[0.067]	[0.012]	[0.004]	[0.021]	[0.021]
Year 2004 ∗ *Eventual entry* ∗ *Classified*						0.097	−0.004	0.001	−0.013	−0.031
						[0.067]	[0.012]	[0.003]	[0.019]	[0.022]
Year 2005 ∗ *Eventual entry* ∗ *Classified*						0.086	−0.000	−0.002	0.011	−0.021
						[0.170]	[0.018]	[0.003]	[0.020]	[0.028]
Newspaper fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Classified ∗ Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,905	6,097	3,884	3,574	4,359	3,905	6,097	3,884	3,574	4,359
Number of newspaper IDs	978	1,892	1,404	896	1,457	978	1,892	1,404	896	1,457
Adjusted *R*-squared	0.132	0.106	0.243	0.017	0.273	0.112	0.108	0.236	0.019	0.274

Notes. This table reports OLS results from regressions on log classified-ad rate, log price, circulation share, differentiation, and log display-ad rate. *classified* is a dummy variable that equals 1 if the newspaper lists a classified-ad manager in that year and 0 otherwise. *Eventual entry* is a dummy variable that equals 1 for all newspapers that ever experience entry by Craigslist into their county by 2007 and 0 otherwise. Its main effect is absorbed by newspaper fixed effects. *Year 2000* ∗ *eventual entry* ∗ *classified* is used as the comparison group. *Year 2007* ∗ *eventual entry* ∗ *classified* is dropped because the value of *eventual entry* is 0 for all observations in 2007. Heteroskedasticity-adjusted standard errors, clustered at the newspaper level, are included in square brackets.

*Significant at 10%; **significant at 5%; ***significant at 1%.

prior to Craigslist's entry and the different trends may cause the empirical patterns we observe after Craigslist's entry. We extend the analysis by including the interactions between the $eventual\ entry_i$ and $classified_{it}$ dummy and each of the year dummies. The three-way interactions capture the difference between affected newspapers and control newspapers in each year prior to Craigslist's entry. We report the results in Models 6–10 of Table 6. We find that for all outcome variables, all coefficients for the interactions are insignificant, suggesting that the affected and control newspapers do not exhibit different trends prior to Craigslist's entry.

Third, we provide robustness tests that use the number of posts on Craigslist, a continuous variable, in place of the dummy variable, $Craigslist\ entry_{it}$. The variable $num\ Craigslist\ posts_{it}$ equals 0 in all years before Craigslist enters a county and is some positive number in each year after Craigslist enters. For all five outcome variables, $classified\ ad\ rate_{it}$, $subscription\ price_{it}$, $circulation\ share_{it}$, $display\ ad\ rate_{it}$, and $differentiation_{it}$, the signs on the coefficient $classified_{it} * Craigslist\ entry_{it}$ match the signs shown in Table 3. Thus, whereas heterogeneity in population tastes or in ease of access to the Internet across markets may lead Craigslist to be more popular in some areas than others, the main results hold even when accounting for these factors.

Fourth, we run a set of analyses that restricts the sample to only those markets that Craigslist enters before 2007 (the last year of our study period). The idea behind such a test is to reduce selection bias that might arise from comparing outcomes in markets that experience Craigslist entry to outcomes in markets that do not experience Craigslist's entry. The temporal variation in Craigslist's entry provides us with enough variation to identify the effect of entry. Even if there are time-varying unobservables that are correlated with the entry decision of Craigslist, as long as these time-varying unobservables affect newspapers with and without classified-ad managers in a similar way, we can identify the effect of Craigslist's entry from the changing gap between affected newspapers (i.e., those with classified-ad managers) and unaffected, or less affected, newspapers (i.e., those

without classified-ad managers) in these markets.[27] Our results are qualitatively unchanged.

Finally, we note that the concern about endogeneity of Craigslist's entry is somewhat alleviated by the peculiar nature of Craigslist's corporate mission. Craigslist is incorporated as a for-profit company, but it still uses the ".org" domain, whereas a for-profit company would typically use the ".com" domain. According to Craigslist, the company does this because the .org domain "symbolizes the relatively noncommercial nature, public service mission, and noncorporate culture of Craigslist."[28] Anecdotal evidence in the popular press provides additional support for the idea that Craigslist may focus on objectives other than profits. For example, in its annual ranking of top private digital companies, Silicon Alley Insider estimates that Craigslist generated about \$150 M in ad revenue in 2009 but could have generated at least \$1 B.[29] Thus, given the anecdotal evidence that the company does not try to maximize profits, but instead some other public service mission-oriented objective, it is plausible that Craigslist's entry into local markets is orthogonal to the financial performance of the newspapers in those markets.

A second potential concern is that the dummy variable $classified_{it}$ may not accurately capture newspapers' reliance on classified-ad revenue. To address this concern we investigate the correlation between $classified_{it}$ and the number of pages of classified ads in a newspaper. We accomplish this by hand counting the number of total pages and number of classified-ad pages for a group of newspapers for each quarter from January 1999 to October 2006.[30] We then create an annual average across quarters for each newspaper and regress annual average classified-ad pages ($num\ ad\ pages_{it}$) on total number of pages, $classified_{it}$, and year dummies. The coefficient on $classified_{it}$ is positive and significant at the 5% level, indicating a strong correlation between $classified_{it}$ and the number of classified-ad pages.

We also perform robustness checks to rule out plausible alternative explanations for the result on the $classified_{it}$ variable. One alternative explanation could be that a large newspaper may have a classified-ad manager even if classified-ad revenue is only a small fraction of its total revenue. To address this concern, we normalize $classified_{it}$ by the total number of managerial positions each newspaper has on its ad sales team and then repeat the analyses as in Table 3. The results are qualitatively unchanged.

Another alternative explanation is that $classified_{it}$ could be endogenous because it is determined in the same time period as the pricing variables. In a robustness check, we fix the value of $classified_{it}$ to its value in 2000. We drop all counties where Craigslist entered on or before 2000 and then run regressions only with observations after 2000. Although the approach does not capture possible shifts in newspapers' reliance on classified-ad revenue, it frees us from the endogeneity concern because the reliance of these newspapers on classified-ad revenue is determined in an earlier period, whereas newspaper responses to Craigslist's entry are examined for later periods. The results are similar to those presented in Table 3.

Our third potential concern is the possibility that the observed newspaper responses are a result of other confounding factors. One natural candidate for such a confounding factor is the entry and exit of newspapers that may change the number of competing newspapers that a given newspaper faces. However, the large amount of temporal and geographical variation in Craigslist's entry pattern helps rule out this explanation because it is unlikely that new newspapers systematically enter the market at the same time as Craigslist. To further rule out this potential concern, we conduct robustness tests that include a count of the number of newspapers in a market; we obtain results similar to those in Table 3.

Finally, we consider the extent to which the results on our differentiation measure are robust to an alternative definition. The differentiation measure we use takes the minimum amount of differentiation between a newspaper and each of its competitors. However, it is possible that a newspaper cares instead about its most significant competitor. As an alternative differentiation measure, after computing the distance measures between newspaper i and each of its competitors, we use zip code circulation data from ABC to estimate the significance of each competitor to newspaper i using the following procedure:

1. Assume that newspaper i circulates in N zip codes with corresponding circulations $Circ_{i1}, \ldots, Circ_{iN}$ (we drop the year index t for simplicity).

[27] The same strategy has been used in other studies, such as George and Waldfogel (2006), which examines the expansion effect of *New York Times* on sales of local newspapers in different education zones. Their identify strategy also hinges on the assumption that unobservables affect both targeted (i.e., those with more education) and nontargeted (i.e., those with less education) consumers in the same market in the same way.

[28] http://www.craigslist.org/about/factsheet, accessed May 22, 2010.

[29] http://www.businessinsider.com/sai-50-2009#5-craigslist-5, accessed August 3, 2010.

[30] The newspapers, which were chosen because of data availability, include *Albany Times Union*, *Baltimore Morning Sun*, *Boston Globe*, *Cincinnati Enquirer*, *Cleveland Plain Dealer*, *Dallas Morning News*, *Denver Post*, *Detroit News*, *Houston Chronicle*, *Indianapolis Star*, *Kansas City Times-Star*, *Louisville Courier Journal*, *New Orleans Times Picayune*, *Oregonian*, *Rochester Democrat and Chronicle*, and *St. Louis Post Dispatch*.

2. Denote newspaper j's circulations in these N zip areas as $Circ_{j1}, \ldots, Circ_{jN}$.

3. Let the total circulation of newspaper i be $Circ_i = \sum_{k=1}^{N} Circ_{ik}$.

4. Following Chen (1996), the significance of newspaper j to newspaper i can be computed as $\sum_{k=1}^{N}(Circ_{jk} \cdot (Circ_{ik}/Circ_i))$.

The measure accounts for two factors: the competitor's market size in each of the markets served by newspaper i and the strategic importance of each of the markets for newspaper i. Note the asymmetry of this measure: If newspaper j is the most significant competitor to newspaper i, it is not necessary that newspaper i is the most significant competitor to newspaper j. Once we compute the significance of each competitor to newspaper i, we then define differentiation to be the distance between newspaper i and its most significant competitor in year t. Results using this alternative measure are similar to those in Table 3.

6. Extensions

Our analysis thus far has focused on changes in newspapers' offline pricing and positioning strategies in response to Craigslist's entry. The impact of Craigslist's entry on newspapers may go beyond offline strategies. We extend our findings by investigating how Craigslist's entry affects newspapers' online content strategies. Newspapers face the dilemma of whether to aggressively move their content online during our study period. On one hand, a growing number of readers obtain news online.[31] Offering content online thus allows newspapers to retain their readers and generate additional revenue from selling ads online. On the other hand, online content, which is often offered for free, is a substitute for print newspapers and cannibalizes newspapers' offline business. Cannibalization becomes a greater concern when newspapers try to generate more revenue from print subscriptions. Hence, we expect that these affected newspapers are less likely to move their content online.

To test this hypothesis, we rerun a set of regressions similar to Equation (1) by replacing the dependent variable with $online\ editor_{it}$ and $MIS\ manager_{it}$, respectively, to examine whether these affected newspapers are more or less likely to have online content editors or MIS managers.[32] One caveat of $MIS\ manager_{it}$ is that although the variable is positively correlated with $online\ editor_{it}$ (correlation = 0.17), it could also capture IT investment unrelated to online content such as investment in the development of online subscription systems. The new dependent variables are dummy variables, so we first use the conditional fixed effects logit model. The coefficients on the interaction, $Craigslist\ entry_{it} * classified_{it}$, are significantly negative in both models. Interaction variables in logit models, however, are hard to interpret (Hoetker 2007, Zelner 2009). We next repeat the analysis using the linear probability model. Angrist and Pischke (2009) show that in several empirical applications, there is little qualitative difference between limited dependent variables models and linear probability models. One major concern about the linear probability model is that predicted probabilities may lie outside the range of 0 and 1. In our case, 100% of the predicted probabilities of both dependent variables lie between 0 and 1. As a result, the linear probability models with robustness standard errors yield unbiased and consistent estimates in our case (Horrace and Oaxaca 2006). The results based on the linear probability models show that Craigslist's entry reduces the likelihood of having an online content editor or an MIS manager by six to seven percentage points for the affected newspapers, which is equivalent to a reduction of 33% and 14%, respectively.[33] In summary, we find that Craigslist's entry significantly reduces the likelihood of moving content online for the affected newspapers.

As another extension, we investigate the financial impact of Craigslist's entry on classified-ad buyers.[34] To estimate their potential savings, we first estimate the classified-ad revenue each newspaper should receive absent Craigslist's entry and aggregate this amount across all affected newspapers. We then multiply this number by the percentage drop in classified-ad revenue as a result of Craigslist's entry. To estimate each newspapers' classified-ad revenue, we first use the group of newspapers for which we have data on the number of classified advertising pages ($num\ ad\ pages_{it}$) to identify the relationship between classified-ad revenue, newspaper size, and whether a newspaper has a classified-ad manager. We run a regression of the following form: $\log(classified\text{-}ad\ rate_{it} * num\ ad\ pages_{it}) = \beta_0 + \beta_1 \log(Circ_{it}) + \beta_2 classified_{it} + \eta_t + \varepsilon_{it}$, where $Circ_{it}$ is newspaper i's circulation in year t and η_t are year fixed effects, for periods before Craigslist's entry in their markets. We then allocate the total classified-ad

[31] For example, according to the 2011 State of the News Media report by Pew's Project for Excellence in Journalism (available at http://www.stateofthemedia.org, accessed March 2011), in 2010, for the first time, more people obtained news online than from print newspapers.

[32] The results are presented in the online appendix.

[33] The means of $online\ editor_{it}$ and $MIS\ manager_{it}$ in Craigslist's entry years are 0.19 and 0.52, respectively.

[34] We have data on rates and prices, but would also need data on costs and quantities to conduct a full welfare analysis. Hence, we only estimate savings to classified-ad buyers.

revenue for the newspaper industry in 2000 ($19.6 billion[35]) to each newspaper in our data set using the weights computed from the regression analysis (i.e., $\exp(\hat{\beta}_1 \log(Circ_{it}) + \hat{\beta}_2 classified_{it})$). We then use the coefficients from the year fixed effects (η_t) to compute the classified-ad revenue each newspaper would have been making each year, absent Craigslist's entry.

To estimate the percentage drop in classified-ad revenue, we next run another regression using the same group of newspapers to estimate the percentage drop in the number of classified-ad pages as a result of Craigslist's entry: $\log(num\ ad\ pages_{it}) = \beta_0 + \beta_1 Craigslist\ entry_{it} + \beta_2 Craigslist\ entry_{it} * classified_{it} + \beta_3 classified_{it} + \beta_4 average\ ISPs_{it} + \eta_t + \varepsilon_{it}$. We find that for newspapers without classified-ad managers, there is no significant drop in the number of classified-ad pages, whereas for newspapers with classified-ad managers, Craigslist's entry leads to 8.5% drop in the classified-ad pages. We know from Table 3 that Craigslist's entry leads to a net of 13.9% (20.7% − 6.8%) drop in the classified-ad rate for newspapers with classified-ad managers. Hence, the average drop in total classified-ad revenue for newspapers with classified-ad managers is $1 - (1 - 13.9\%) * (1 - 8.5\%) = 21.2\%$.

The amount of savings for classified-ad buyers can thus be computed as the product of the total classified-ad revenue that newspapers with classified-ad managers could have made after Craigslist's entry and the average revenue drop as a result of Craigslist's entry. Using this approach, we find that Craigslist's entry leads to a total savings of $2.8 billion (year 2000 dollars) for years 2000 and 2002–2005 (i.e., years for which we have data on both classified-ad managers and classified-ad rates). We then compute the savings per capita by dividing the total saving by the total population affected by Craigslist's entry during this period. Assuming that savings per capita stays constant, we extrapolate total savings to the period 2000–2007 and estimate that Craigslist's entry results in total savings of $5.0 billion (year 2000 dollars) to classified-ad buyers during the 2000–2007 period.

Note that this estimate is likely to be a lower bound of savings for classified-ad buyers for two reasons. First, many classified-ad buyers could have been advertising to other offline outlets such as weekly newspapers, and their savings are not reflected in this analysis. Second, as Craigslist continues to penetrate each market, more classified-ad buyers may switch to Craigslist's services. Hence, its impact may become more pronounced during the 2006–2007 period. The analysis shows that although Craigslist's entry is disruptive to the newspaper industry, it provides significant cost savings to classified-ad buyers.

[35] See http://bit.ly/wnsFK8, accessed June 2012.

7. Discussion and Conclusion

We study the impact of Craigslist's entry on local U.S. newspaper business models. We provide evidence that, relative to newspapers without classified-ad managers, the effect of Craigslist's entry on newspapers with classified-ad managers leads to a decrease of 20.7% in classified-ad rates, an increase of 3.3% in subscription prices, a decrease of 4.4% in circulation, an increase of 16.5% in differentiation, and a decrease of 3.1% in display-ad rates. The timing of these effects is consistent with the idea that Craigslist's entry provides a shock to the classified-ad side of a newspaper's market that propagates to the other sides of the market as the newspaper adjusts its business model. We also provide two extensions. First, we show that these affected newspapers are less likely to make their content available online. Second, we estimate the total savings to classified-ad buyers from Craigslist's entry during 2000–2007 to be $5.0 billion (in year 2000 dollars).

Our findings are consistent with the following story: Craigslist's entry decreases the attractiveness of a newspaper to classified advertisers, which now have an alternative channel to reach newspaper subscribers. As a result, the affected newspaper decreases the classified-ad rate. The newspaper now has a lower incentive to subsidize the subscriber side because each eyeball no longer generates the same amount of ad revenue as before, a finding consistent with existing theory (e.g., Godes et al. 2009, Hagiu 2009). To capture more value from its subscribers, the newspaper chooses to differentiate further from its competitors on the subscriber side. The reduced competitive intensity allows the newspaper to charge a higher subscription price, a finding consistent with another set of existing theories (e.g., Gabszewicz et al. 2001, 2006; Peitz and Valletti 2008). Furthermore, to capture more value from its subscribers, the newspaper chooses not to offer free online content, which would cannibalize offline content. The increase in the subscription price in turn leads to lower circulation, making the newspaper less attractive to display advertisers. As a consequence, the newspaper decreases its display-ad rate to compensate the display-ad buyers for the lower number of readers. We want to emphasize, however, that although our findings are consistent with the above story, we cannot entirely rule out alternative stories. We address some of these alternative stories when discussing limitations below.[36]

7.1. Managerial Implications

Our study illustrates the challenges faced by platforms in multi-sided markets when responding to

[36] For a stylized model linking the results across the three sides of a newpaper's platform, see Seamans and Zhu (2013).

entrants. First, because different sides of a platform's market are often interdependent with each other, changes on one side of the market tend to propagate to other sides. As a result, platforms need to be cognizant of the multi-sidedness of their markets and consider all sides together when designing optimal strategies. Conventional wisdom from one-sided markets may be misleading in multi-sided markets. As we illustrate empirically in our study, sometimes a platform needs to *increase* its price on one side of its market as an optimal response to increased competition on another side. Moreover, the optimal response may not be limited to one mechanism, such as a change in price, but may also require a corresponding change in quantity as well as product characteristics to allow a platform to differentiate itself from competitors.

Our work also provides empirical evidence that the Internet has substantial impact on offline media firms. Offline media firms are not only affected by online content providers such as blogging sites and video-sharing sites that provide similar content but are also affected by online service providers that compete away advertisers. More generally, our study helps build an understanding of how media platforms respond to shocks from technologically disruptive entrants from different industries. This issue is important because the boundaries between media industries are blurred today: advertisers can reach relevant consumers through a variety of channels such as TV, the Internet, and mobile devices. Therefore, platforms are likely to be unprepared for competition if they rely on industry boundaries to identify their competitors. They also need to be cognizant that optimal responses sometimes involve changes in their business models toward charging more on the consumer side (e.g., from pure ad-sponsored business models to business models with both subscriptions and ads). Such changes can be particularly challenging in an environment such as the media industry where consumers are increasingly expecting their consumption to be free (Wray 2010).

7.2. Limitations and Future Research

Although we are able to take advantage of geographic and temporal variation in Craigslist's entry patterns to rule out a number of alternative explanations, a few limitations remain. For example, we observe that newspapers with classified-ad managers are more likely to experience a decline in display-ad rates, but we cannot identify whether this decline is caused by the decrease in newspaper subscribers, as suggested by the results in Table 4, or by some small display advertisers substituting away from higher-priced display ads to simple online classified ads after Craigslist's entry. Display advertisers are often less price sensitive and care more about their brand image than do classified advertisers, however, so we expect the effect from the latter case to be small.

Second, subscribers' substitution away from newspapers to other forms of media, such as Craigslist, may also contribute to the drop in newspaper circulation. This might occur, for example, if a portion of the circulation is to individuals who purchase newspapers to search classified ads for temporary-work opportunities. The interdependence of newspaper sales and the number of classified ads is more likely to exist for newspapers sold at newsstands. Our focus on yearly subscription prices and circulation data helps alleviate this concern. Indeed, other empirical studies (e.g., Argentesi and Filistrucchi 2007) using yearly data find no effect of ads on sales for daily newspapers.

Third, we treat newspapers independent of each other, when in fact many are owned by the same parent firm. One possibility is that a newspaper with a parent that owns newspapers in other markets that experienced Craigslist's entry may have moved further down the learning curve (Lieberman 1987) and be able to react faster to Craigslist's entry. For example, such newspapers may drop classified-ad rates in anticipation of Craigslist's entry, in an attempt to lock in classified advertisers. Our results in Table 4 provide no evidence of such pretreatment effects. Moreover, to the extent this occurs, it biases against our finding a result, suggesting that the full effect of Craigslist's entry on newspaper classified-ad rates may be understated. However, a full understanding of how a newspaper group learns from Craigslist's entry is beyond the scope of the current article, but it is an interesting area for future research.

Finally, existing research on multi-sided markets tends to focus on the pricing response alone, but as we document in this paper, firms have other mechanisms at their disposal. For example, we show that newspapers use pricing, circulation, and content positioning when responding to Craigslist's entry. It is possible that newspapers used other mechanisms in response to Craigslist's entry. However, to the extent that newspapers did use other mechanisms, it biases against our finding an effect for the mechanisms we study. More broadly, we hope that the patterns we describe in this paper help inform other theoretical and empirical research that studies how firms change their business models in response to entry in a multi-sided market setting.

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