Technology Shocks in Multi-Sided Markets: The Impact of Craigslist on Local Newspapers

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Abstract

We empirically examine the impact of Craigslist, a website providing classified advertising services, on local newspapers in the United States. We exploit temporal and geographic variation in Craigslist's entry and compare the pricing strategies of local newspapers for which classified ads are likely to be a significant portion of their revenue to others before and after Craigslist's entry. We find that these newspapers drop their classified ad rates more after Craigslist's entry. Relative to other newspapers, these newspapers also experience an increase in subscription price, decrease in circulation share, and decrease in display ad rates. We find no evidence that the content of these newspapers differs from other newspapers following Craigslist's entry. These findings are consistent with a model viewing the newspaper industry as a three-sided market where the impact of Craigslist's entry in the classified ad side propagates to the reader and display ad sides.

1. Introduction

The fate of traditional media such as radio, TV and newspapers has received much attention since the inception of the Internet (e.g., Athey, Calvano and Gans, 2010). On one hand, the number of voices warning of traditional media's demise has increased over the years given the growing popularity of online media. On the other, in the past traditional media has survived threats from, and learned to coexist with, new technologies. For instance, the newspaper industry successfully responded to threats from radio in the 1920s and TV in the 1950s (e.g., Jackaway, 1995). Quantifying the impact of the Internet on traditional media is difficult for several reasons. First, the gradual diffusion of the Internet is likely to be correlated with many macro trends that may also affect demand for traditional media. Second, different kinds of products or services on the Internet may affect traditional media in different ways. For example, the emergence of social media such as blogs and video-sharing sites draw consumers away from traditional media. The growing popularity of online advertising reduces the attractiveness of traditional media to advertisers. It is thus difficult to empirically identify mechanisms through which the Internet affects traditional media.

In this study, we take advantage of the temporal and geographic variation in entry by Craigslist, a website providing classified ad services, to examine its impact on local US newspapers. Craigslist offers classified ads for free in most cases.[1] In addition, ads on Craigslist are easy to search, and are updated in real time, unlike a newspaper. We therefore expect Craigslist's entry to significantly reduce the attractiveness of newspapers to classified ad buyers and thus reduce newspapers' classified ad rates. We adopt a differences-in-differences approach that compares local newspapers for which classified ads are likely to be a significant fraction of revenue to others before and after the entry of Craigslist. We identify such newspapers by whether or not the newspaper has a classified ad manager. We find

[1] 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 2010.

that these newspapers drop classified ad rates more than other newspapers following Craigslist's entry. Newspapers are platforms that link together three different groups: readers, classified ad buyers and display ad buyers[2]. Hence, we next examine how the impact of Craigslist's entry on the classified ad side propagates to the other two sides of the market. We find that newspapers with classified ad managers increase subscription prices relative to newspapers without classified ad managers following Craigslist's entry. As a result, their circulation shares drop more. Because of the drop in the circulation shares, their display ad rates decrease more as well following Craigslist's entry. Finally, we find no evidence that the content of affected newspapers change with Craigslist's entry, which helps to rule out a change in newspaper targeting as an alternative explanation to our findings.

Our paper contributes to several streams of research. First, our work is related to the literature on incumbent responses to entry. Prior studies in strategy and economics have shown that incumbents may use a variety of competitive weapons such as pricing, advertising, new product introductions and excess capacity to respond to new entrants (e.g., Geroski 1995; Lieberman 1987, 1989; McCann and Vroom, 2010; Seamans 2010; Simon 2005). Our work focuses on incumbents' pricing responses and extends this literature by showing that in multi-sided markets, such pricing responses on different sides of the markets are interdependent.

Second, our empirical findings provide support for theoretical work in multi-sided markets (e.g., Rochet and Tirole 2003; Caillaud and Jullien 2003; Armstrong 2006), which shows that when the competition on one side of the market becomes more intense, the price on the other side may increase (Hagiu 2009; Godes, Ofek and Sarvary 2009). These findings are in sharp contrast to those in a regular one-sided market where competition typically lowers prices (e.g., Simon 2005). Anecdotal evidence supports this theoretical prediction. For example, most newspaper websites in the 1990s offered their content for free and financed themselves

[2] Display ads are used by businesses to promote their products and services and are displayed alongside regular editorial content. In contrast, classified ads typically have a separate section.

exclusively by advertising revenues. As the number of online content sites increased, many newspaper websites switched to subscription-based business models (Casadesus-Masanell and Zhu 2010).[3] The intuition is that when a new media platform enters a market, the number of advertisers available to incumbent platforms drops. Since part of the value of attracting consumers is that it allows the platform to raise price to advertisers, the return per customer decreases as the number of advertisers per incumbent decreases, making incumbent platforms less willing to under-price content to increase demand. Few studies except Jin and Rysman (2010) provide direct tests of this prediction[4]. Jin and Rysman study sportcards conventions and show that prices to consumers rise and prices to dealers drop as competition between platforms (the conventions) increases. As the directions of price changes hinge on the relative intensity of competition on each side of the market, their paper relies on variation in geographic distance between conventions to infer asymmetric degree of competition for consumers and dealers. Our paper differs from Jin and Rysman in several aspects. First, Craigslist's entry only affects one side of the market as Craigslist does not provide any 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 analysis in a three-sided market setting reveals that the direction of price change 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. As a result, display ad rates actually drop as competition on the classified ad side intensifies. Finally, our study employs a differences-in-differences research design that uses panel data on newspapers together with Craigslist's geographical and temporal entry patterns.

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[3] One example would be the website of the *New York Times*. For other examples, see http://paidcontent.org/article/419-taking-the-plunge-how-newspaper-sites-that-charge-are-faring/ for a partial list of newspaper sites charging fees to readers.

[4] Much of the empirical literature on multi-sided markets focuses on quantifying indirect network effects in these markets (e.g., Gandal, Kende and Rob 2000; Nair, Chintagunta and Dubé 2004; Clements and Ohashi 2005; Rysman 2004, 2007), evaluating exclusive contracting between platforms and application developers (e.g., Derdenger 2010; Lee 2010; Corts and Lederman 2009) and examining conditions under which tipping occurs (e.g., Cantillon and Yin 2008; Zhu and Iansiti forthcoming).

We also add to the literature on newspaper responses to competition. Chandra and Collard-Wexler (2009) study Canadian newspaper mergers and show that decreased competition between platforms need not lead to higher subscription or advertising prices. Our paper studies the effect of increased competition in one of the markets served by the platform, instead of on competition between platforms. George and Waldfogel (2006) show that increased competition from the *New York Times* leads local papers to shift away from national or foreign news, areas in which the *New York Times* has a comparative advantage, to more local news stories. Chandra (2009) shows that competition may lead newspapers to do better targeting, allowing the newspaper to raise prices to advertisers. In contrast, our study shows that the newspapers for which classifieds are important do not appear to target new audiences in response to Craigslist's entry, indicating that the main response by newspapers is to change pricing, rather than to change content.

The rest of the paper is organized as follows. Section 2 presents background information on Craigslist. Section 3 describes our data. Section 4 presents results from our empirical analysis. Section 5 presents a simple model of a three-sided market that illustrates how the impact of Craigslist's entry in the classified ad side of the newspaper market propagates to the subscriber and display ad sides. We conclude in Section 6.

2. Craigslist's Expansion

Craigslist is a website that specializes in online classified listings. It began the service 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 9 more US cities in 2000, 4 in 2001 and 2002 each, 14 in 2003, and many more cities in recent years. It selects cities based on user requests. As of 2010, Craigslist is available for more than 700 local sites in 70 countries.[5] The site serves over twenty billion page

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

views per month, and is the 7th most visited web site in the United States.[6] With over fifty million new classified advertisements each month[7] and about sixty million unique visitors in the US each month[8], Craigslist is the leading classifieds service in any medium.

As revenues from classified ads account for 40% of a newspaper's total revenues on average,[9] the introduction 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 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."[10] Figure 1 provides suggestive evidence on the drop in classified ad listings following entry by Craigslist. This figure shows the results of a regression of log classified ad pages from eleven randomly selected newspapers on dummies for quarters since Craigslist's entry. The figure reveals a perceptible decrease in the number of classified ad pages following Craigslist's entry. Our analysis below provides more rigorous empirical evidence of how Craigslist's entry leads to a decrease in affected newspapers' classified ad rates.

Our empirical setting provides several advantages for examining newspapers' responses to increased competition. First, temporal and geographical variation in the expansion of Craigslist into different markets allows us to establish causal relationship.[11] The environment is a complex one: many technological changes, in particular, the diffusion of the Internet, have affected the newspaper industry. For example, websites such as eBay.com and monster.com also attract classified advertisers, and content sites such as blogs and Google news attract many

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[6] http://www.alexa.com/siteinfo/craigslist.org, accessed July 2010.
[7] http://www. craigslist.org/about/factsheet, accessed July 2010.
[8] http://siteanalytics.compete.com/craigslist.org/, accessed July 2010.
[9] See Swarts, Will. "Craigslist: Stopping the Presses?" at *Smart Money*, September 7, 2005. Source: http://www.smartmoney.com/investing/stocks/craigslist-stopping-the-presses-18189/, accessed December 2009.
[10] See, for example, http://www.sfbg.com/40/18/x_editors_notes.html, http://nymag.com/nymetro/news/media/internet/15500/, http://sfist.com/2004/12/29/craigslist_newspaper_killer.php, and http://www.forbes.com/2006/12/08/newspaper-classifield-online-tech_cx-lh_1211craigslist.html, accessed July 2010.
[11] For example, Kroft and Pope (2008) also take advantage of Craigslist's entry pattern to study the effect of Craigslist's expansion on rental vacancy rates and unemployment rates.

newspaper readers away from newspapers. Unlike Craigslist, these sites contemporaneously serve consumers in all regions in the US. As a result, we are able to use year dummies and their interactions with newspaper types to control for their overall effects on newspapers and disproportionate effects on different types of newspapers. Second, the theoretical result that price on one side of a two-sided market increases is contingent on the condition that the competition increases more significantly on the other side. In our setting, we expect to see significant increase in competition on the classified ad side relative to the subscriber side. Hence, our setting is ideal for testing the direction of price changes. Third, one of the empirical challenges of studying multi-sided markets is collecting price 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 agreement on prices between console providers and game publishers. We are able to collect prices on all three sides of the newspaper market.

3. Data

Table 1 provides summary statistics of variables used. We have different numbers of observations for these variables because the data were collected from several sources. Information on the date of Craigslist's entry into different markets is from Craigslist, with additional details on dates from older versions of the Craigslist website.[12] Using this information we create a dummy variable $craigslist\_entry_{it}$ that equals one for all years after Craigslist enters the newspaper's local market and zero otherwise. We define the relevant market to be the county in which the newspaper is based. Other papers have defined the relevant market at the zip code (Chandra, 2009) or MSA level (George and Waldfogel, 2006). We use county to be consistent with Craigslist's product offerings, which sometimes vary by

[12] The company lists the dates and locations of its expansion here: http://www.craigslist.org/about/expansion. From November 2006, the site only lists the number of cities entered, so we supplemented with information from older Craigslist websites found on the Internet Archive.

county or by state region. For example, Craigslist has separate pages for La Salle County, Illinois, Fairfield County, Connecticut, Western Maryland and Eastern North Carolina, to name a few. Information on classified ad rates is from the *SRDS Newspaper Advertising Source* (SRDS) for years 1999-2006. SRDS does not provide the same newspaper characteristics as *Editor & Publisher International Yearbooks* (E&P), so we match newspaper characteristics from the E&P database as described below.

Information on each newspaper's yearly circulation, subscription price, display ad rate, year founded, political leaning and editor or ad manager type is from *Editor & Publisher International Yearbooks* (E&P) for years 1998, 1999, 2001, 2003, 2004, 2005, 2006 and 2008. The yearbooks contain data on virtually every newspaper in the U.S. and such data are also used by the US census to compile summary statistics for the annual *Statistical Abstract of the United States.* Information published in these yearbooks is current as of the year prior to publication. We construct the variable $classified_{it}$ from a field that lists positions in the advertising sales management team. If one or more positions include the word "classified" then we code $classified_{it}$ as one, otherwise as zero. We use this variable to indicate those newspapers which rely heavily on classified ads, and hence we expect those newspapers to be significantly affected by the entry of craigslist. The dummy variable $independent_i$ equals one if the newspaper's politics in 2005 is listed as independent, and zero otherwise.[13] The continuous variable $newspaper\_age_i$ is the difference between the year in the sample and the year the newspaper was founded. Information about the newspaper's editors was collected to create shares of editor types. We accomplish this by categorizing each editor's title into one of the following types: art, business, entertainment, home, local, national, opinion, special, sports and technology. Shares have been created for each newspaper and year by summing the number of editors under each type and dividing by the total number of editors. To measure content variety of a newspaper, we also construct a variable $total\_positions_{it}$ which is the total number of editor types at a newspaper.

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

We collect county level demographic data, including age_i, $population_i$, $pct\_college\_degree_i$, $per\_capita\_income_i$ and $pct\_renters_i$ from the U.S. Census Bureau for use in robustness tests. The population data is used as a denominator to transform the circulation variable into circulation share. We also collect information on the number of high speed internet service providers (ISPs) at the zip code for 2000-2008 from the Federal Communications Commission. This information is then averaged across all the zip codes in the county. The population data is used as a denominator to transform the number of ISPs in the county into the variable $average\_ISPs_{it}$. This variable is included to control for diffusion of the Internet within the relevant market, which may affect newspapers' strategies.

We use internetarchive.org to access historical pages of Craigslist for each year of all of the markets in our sample, and from these pages we gather counts of the numbers of posts in each category. For example, in Boston on February 7 under the category "sale/wanted" there were 2,725 posts listed under "general for sale" and 730 posts listed under "items wanted" (see Figure 2). These category counts are then aggregated up to the market level to create a variable $number\_of\_posts_{it}$ which we use in robustness checks described below. Over the years, Craigslist 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 had since its inception. When internetarchive.org archives the same Web page multiple times in a single year, we take the average of these counts.

4. Empirical Analysis

4.1 Impact of Entry on Classified Ad Side

Our goal is to study how local newspapers respond to entry by Craigslist. To do this, we first focus on the effect of Craigslist's entry on classified ad rates. The empirical design relies on a differences-in-differences approach that compares

classified ad rates after Craigslist's entry to rates before Craigslist's entry for newspapers with a classified ad manager to those without. The specification will be of the following form:

(1) $classified\_ad\_rate_{it} = \beta_0 + \beta_1 craigslist\_entry_{it} + \beta_2 craigslist\_entry_{it} * classified_{it} + \beta_3 classified_{it} + X_{it}\delta + \gamma_i + \eta_t + \varepsilon_{it,}$

where $classified\_ad\_rate_{it}$, $craigslist\_entry_{it}$, and $classified_{it}$ are as described above, X_{it} is a vector of other 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. 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 businesses. We therefore include interactions between $classified_{it}$ and year dummies in X_{it}. 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 local newspaper's classified ad business. We cluster the error terms at the level of the newspaper to account for autocorrelation in the data across newspapers and over time (Bertrand et al, 2007).

Table 2 reports regression results on log classified ad rates. All the models include newspaper and year fixed effects. Model 1 includes the dummy variable for $craigslist\_entry_{it}$ and a dummy for $classified_{it}$; neither of which is significant. Model 2 replicates Model 1 and adds an interaction between $classified_{it}$ and $craigslist\_entry_{it}$. The coefficients on $craigslist\_entry_{it}$ and $classified_{it}$ remain insignificant, whereas the coefficient on their interaction is negative and significant. This result indicates that newspapers with classified ad managers were on average more likely to lower classified ad rates following entry by Craigslist. Model 3 replicates Model 2 and adds the interactions between year dummies and $classified_{it}$. Models 4 and 5 focus on a subsample of years for which ISP data is available. Model 4 replicates Model 3 on this subsample. Model 5 replicates Model 4 and adds the number of ISPs as a

control. The results across the models are broadly similar; namely, newspapers with classified ad managers were on average more likely to lower classified ad rates by about 18.5% (based on Model 5) following entry by Craigslist. Our result that Craigslist acts as a substitute for newspapers' classified services is consistent with prior studies on the relation between online and offline channels (Filistrucci, 2005; George, 2008; Brynjolfsson et al. 2009; Forman et al. 2009; Goldfarb and Tucker 2011a, 2011b).

4.2 Propagation of Craigslist's Entry to Other Sides

We next investigate how the effect of Craigslist's entry propagates to the reader side and display ad side. We focus on three dependent variables: newspaper's subscription prices, circulation shares and display ad rates. We replicate Models 3 and 5 from Table 2 (i.e., with and without $average\_ISPs_{it}$, respectively) and report the results in Table 3. We find that the coefficient on $classified_{it}$*$craigslist\_entry_{it}$ is significant in all models except Model 5, suggesting Craigslist's entry does influence the reader side and display ad side. In particular, we find that subscription prices of these affected newspapers increase by 3.6%, yearly circulations drop by 5.7%, and display ad rates drop by 3.5% (based on Models 2, 4 and 6, respectively). It is worth noting that the magnitudes of the effects presented in Table 3 are small relative to the effects presented in Table 2. These results accord well with the idea that the immediate effect of Craigslist's entry is to the newspaper's classified ads business, but that the effect of Craigslist's entry propagates into the other sides of the market gradually. In Section 5, we use the findings presented in Tables 2-3 to motivate a simple model of how these effects propagate from one market into the others.

4.3 Exploring Robustness

One benefit of studying newspaper responses to Craigslist is that Craigslist's product is similar across markets in a given year, making it easy to compare entry

events. For example, the Craigslist webpage for Boston in February 2003 is nearly identical to the Craigslist webpage for Chicago in February 2003 (see Figures 2 and 3). Of course, heterogeneity in population tastes or in ease of access to the Internet across markets means that Craigslist may be more popular in some areas than others. To account for this, 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 zero in all years before Craigslist enters a county and is some positive number in all years after Craigslist enters. Table 5 provides regression results for the four outcome variables, $classified\_ad\_rate_{it}$, $subscription\_price_{it}$, $circulation\_share_{it}$ and $display\_ad\_price_{it}$. The signs on the coefficient $classified_{it}*craigslist\_entry_{it}$ match the signs described in Tables 2 –3.

We are also concerned about the possibility that the observed newspaper responses are a result of repositioning of newspapers. Indeed, other research shows that newspaper content becomes more targeted in response to competition (George and Waldfogel, 2006; Chandra, 2009). To examine whether newspapers become more targeted in response to Craigslist's entry, we investigate the effect of Craigslist's entry on shares of different types of editors at each newspaper. We present the results of these analyses in Table 4. In Model 1, we examine how Craigslist's entry affects content variety of newspapers by focusing on $total\_positions_{it}$. In Models 2-11, we explore targeting by focusing on the share of each editor type. In all models, the coefficient of the interaction term $classified_{it}*craigslist\_entry_{it}$ is insignificant, indicating that those newspapers with a classifieds editor who experience entry by Craigslist behave no differently in setting their content than other newspapers. Hence, there is little evidence that any of the responses by these affected newspapers are driven by content shifts.

Finally, we are concerned that Craigslist's entry may be endogenous. While 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. This concern is somewhat alleviated by the peculiar nature of Craigslist's corporate mission. Craigslist is

incorporated as a for-profit company, but is not necessarily a profit maximizing company. For example, it still uses the ".org" domain, whereas a for-profit company would typically use the ".com" domain. The reason the company does so is that the ".org" domain "symbolizes the relatively non-commercial nature, public service mission, and non-corporate culture of craigslist."[14] The fact that the company does not actively work to maximize profits is well documented in the press. For example, in its annual ranking of top private digital companies, Silicon Alley Insider estimates that Craigslist generated about $150M in ad revenue in 2009, but could have generated at least $1B.[15] Thus, given that the company does not try to maximize profits, it is plausible that Craigslist's entry into newspaper markets is orthogonal to profit characteristics of the newspapers in those markets.

To systematically address the possibility of endogeneity, we take advantage of the geographical and temporal variation in Craigslist's entry to examine factors influencing Craigslist's entry decisions. We run hazard models to predict Craigslist's entry into a newspaper's market as a function of county demographics in which the newspaper is located as well as newspaper characteristics. Table 6 presents the results. Model 1 of Table 6 includes market characteristics such as the demographic variables age_i, $population_i$, $pct\_college\_degree_i$, $per\_capita\_income_i$, $pct\_renters_i$, and $average\_ISPs_{it}$. Model 2 adds in newspaper characteristics including $classified_{it}$, $independent_i$ and $newspaper\_age_i$. We find that $population_i$, $pct\_college\_degree_i$ and $pct\_renters_i$ are significant predictors of Craigslist's entry and these factors are controlled in the foregoing analyses by the use of fixed-effects. In addition, adding newspaper characteristics do not increase explanatory power of the model much, and none of the three newspaper characteristics are significant. The result increases our confidence in the exogeneity of Craigslist's entry.

We also conduct a falsification test using Craigslist's entry pattern to examine the role of location-specific unobservables. We compare pricing strategies of newspapers that would be affected by Craigslist's entry (i.e., those newspapers with classified ad managers and located in counties Craigslist enters) prior to Craigslist's

[14] http://www.craigslist.org/about/factsheet, accessed May 22, 2010.
[15] http://www.businessinsider.com/sai-50-2009#5-craigslist-5, accessed August 3, 2010.

entry into their markets to those of others. If our assumption of the orthogonality between Craigslist's entry and 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, $eventual\_entry_i$, which is 1 if Craigslist enters location *i* at any time before 2008 and 0 otherwise. We then repeat our differences-in-differences analysis by replacing $craigslist\_entry_{it}$ with $eventual\_entry_i$ and only analyzing observations for which $craigslist\_entry_{it}$ is 0. Table 7 reports the results. We find that there is no significant correlation between each of the four outcome variables, classified ad rate, price, circulation share and display ad rate, and the interaction between $eventual\_entry_i$ and $classified_{it}$ during periods prior to Craigslist's entry into their markets. The effect of $eventual\_entry_i$ is absorbed by the newspaper fixed effects. The absence of such false positives further increases our confidence in the exogeneity assumption.

5. A Simple Model

In this section, we present a simple stylized model to study the impact of Craigslist's entry into newspaper markets and to link our empirical findings together. Our model extends Armstrong (2006) to consider three-sided interactions.

Consider a situation where a newspaper charges a fixed fee of α to each classified advertiser, β to each display advertiser and *p* to each subscriber. Assume that there are *m* classified advertisers. Classified advertisers are identified by parameter θ which is uniformly distributed in [0, 1]. The type-θ advertiser makes profit θ when a reader of the newspaper sees its ad. Hence, if the circulation of the newspaper is *D*, only classified advertisers with type $\theta \geq \alpha/\mathrm{D}$ will be willing to pay to advertise. Then the number of classified advertisers that advertise to the newspaper will be $m(1-\alpha/D)$ and $\alpha m(1-\alpha/D)$ is the profit from classified ads.

The setup is similar on the side of display advertisers. Assume the size of display advertisers is *n*. We similarly obtain that the newspaper profit from display advertisers will be $\beta n(1-\beta / D)$.

On the subscriber side, we assume that the market size is *S* and the demand for the newspaper, i.e., circulation, is $D = S(1-p)$. Hence, the newspaper subscription profit will be Dp.

The total profit of the newspaper is thus:

$$\pi(\alpha, \beta, p) = \alpha m(1-\alpha / D) + \beta n(1-\beta / D) + Dp,$$

where $D = S(1-p)$. The newspaper maximizes its profit by setting α, β and *p* simultaneously. Taking the first order conditions with respect to α, β and *p,* we have:

$$p = \frac{1}{8}(4-m-n) \text{ and } \alpha = \beta = \frac{1}{2}S(1-p).$$

The equations are intuitive. As the number of potential classified advertisers or display advertisers increases, the newspaper is more willing to lower the subscription price to increase its subscription. In addition, the classified ad rate and display ad rate increase as price decreases because a lower price increases subscription, making the newspaper more attractive to advertisers. When a competitor, such as Craigslist, enters it attracts classified advertisers away from the incumbent newspaper. Thus, competitor entry reduces the number of potential classified advertisers, *m*, for the newspaper. As *m* decreases, *p* increases, and α and β decrease. In addition, the circulation share, D / S, decreases.

The model helps to interpret our empirical findings. The model suggests that Craigslist's entry in the classified ads market decreases the classified ad rate and thus reduces the return per reader. As a result, the newspaper has a lower incentive to subsidize the subscriber side and the subscription price increases. The increase in subscription price in turn leads to lower circulation, making the newspaper less attractive to display advertisers. Display ad rates drop as a consequence.

The relationship between classified ad rate and subscription price is consistent with findings in Hagiu (2009), Godes, Ofek and Sarvary (2009) and Jin

and Rysman (2010). We extend these findings by showing that in a three-sided market setting an increase in competition on one side does not necessarily increase prices on other sides. The direction of price change depends on the interdependency across different sides. In our case, the display ad side does not interact directly with the classified ad side; they are linked to each other through the subscriber side.

6. Concluding Remarks

Broadly, this study helps build an understanding of how incumbent media platforms respond to technologically disruptive entrants from different industries. This issue is important because the boundaries between media industries are blurred for advertisers today as they can reach relevant consumers through a variety of channels such as TV, the Internet and mobile devices. This study quantifies the impact of Craigslist on local newspapers in the United States. We provide evidence that following Craigslist's entry, newspapers with classified ad managers experience a decrease of 18.5% in their classified ad rates, an increase of 3.6% in subscription price, a decrease of 5.7% in circulation and a decrease of 3.5% in display ad rates. The responses are consistent with a model of a three-sided market which suggests that competition on one side of a platform's market may influence the platform's strategies on other sides.

While 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, while we observe that newspapers with classified ad managers are more likely to experience a decrease in display ad rates, we cannot identify whether this decrease is due to the decrease in newspaper subscribers, as suggested by our model, or due to some small display advertisers substituting away from higher priced display ads to simple online classified ads after Craigslist's entry. On the other hand, as display advertisers are often less price-sensitive and care

more about their brand images than classified advertisers, 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 in order to search classified ads for temporary work opportunities. However, our focus on yearly subscription prices and circulation data help alleviate this concern.

Finally, we treat newspapers independent of each other, when in fact many newspapers are owned by the same parent firm. One possibility is that a newspaper with a parent which owns newspapers in other markets which 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 advertising rates in anticipation of Craigslist's entry in an attempt to lock in classified advertisers. To the extent this occurs, it biases against our finding a result, suggesting that the full effect of Craigslist's entry on newspaper classified advertising rates may be understated. In any case, a full understanding of how a newspaper group learns from Craigslist's entry is beyond the scope of the current paper, but is one area for future research.

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Table 1:

Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Dummy for Craigslist Entry	0.08	0.28	0.00	1.00
Log Number of Posts	0.84	2.60	0.00	12.60
Log Classified Rate	1.31	0.85	-2.21	4.96
Log Annual Subscription Price	4.71	0.39	1.79	6.10
Circulation Share	0.19	0.12	0.00	0.88
Log Display Ad Rate	3.28	0.90	1.25	6.19
Dummy for Classified Editor	0.35	0.48	0.00	1.00
Independent	0.92	0.28	0.00	1.00
Year Founded	1887	36	1764	2000
HHI of Editor Type	0.35	0.27	0.11	1.00
Art Editors	0.09	0.13	0.00	1.00
Business Editors	0.06	0.09	0.00	1.00
Entertainment Editors	0.05	0.09	0.00	1.00
Home Editors	0.12	0.17	0.00	1.00
Local Editors	0.16	0.18	0.00	1.00
National Editors	0.01	0.06	0.00	1.00
Opinion Editors	0.13	0.14	0.00	1.00
Special Section Editors	0.09	0.12	0.00	1.00
Sports Editors	0.24	0.27	0.00	1.00
Technology Editors	0.05	0.09	0.00	1.00
Average Number of ISPs	3.14	2.02	0.00	16.00
Age (County)	36.69	3.00	23.06	54.30
Population (County)	357383	1048498	2681	9891484
Pct. College Degree (County)	0.13	0.05	0.03	0.40
Per Capita Income (County)	19497	4545	9872	44962
Pct Rental (County)	0.31	0.08	0.12	0.80

Table 2:

Impact of Craigslist's Entry on Log Classified Ad Rates (OLS Models)

Model	(1)	(2)	(3)	(4)	(5)
Dependent Variable		All Years		Years>=2000	
Craigslist Entry	-0.0490	0.0791	0.0822	0.0589	0.0434
	[0.0504]	[0.0810]	[0.0814]	[0.0755]	[0.0752]
Classified	0.0074	0.0159	-0.0016	0.0381	0.0420
	[0.0246]	[0.0250]	[0.0466]	[0.0332]	[0.0330]
Craigslist Entry*Classified		-0.2145**	-0.2240**	-0.1903**	-0.1849**
		[0.0955]	[0.0958]	[0.0938]	[0.0937]
Average ISPs					-0.4683*
					[0.2475]
Newspaper Dummies	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Classified * Year Dummies	No	No	Yes	Yes	Yes
Observations	4,611	4,611	4,611	4040	4040
Number of Newspaper IDs	1,036	1,036	1,036	995	995
Adjusted R-squared	0.182	0.184	0.184	0.130	0.131

Table 3:

Propagation of the Effect of Craigslist Entry (OLS Models)

Model	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Log Price		Circ Share		Log Display Ad Rate	
Craigslist Entry	-0.0262***	-0.0141	0.0016	0.0003	0.0282**	0.0134
	[0.0099]	[0.0086]	[0.0017]	[0.0016]	[0.0133]	[0.0126]
Classified	0.0141	-0.0356**	0.0004	0.0007	-0.0213	-0.0096
	[0.0124]	[0.0169]	[0.0032]	[0.0017]	[0.0145]	[0.0121]
Craigslist Entry*Classified	0.0479***	0.0348**	-0.0053*	-0.0047*	-0.0276	-0.0353**
	[0.0158]	[0.0149]	[0.0031]	[0.0025]	[0.0185]	[0.0171]
Average ISPs		0.0767**		-0.0458**		-0.1253**
		[0.0384]		[0.0199]		[0.0531]
Newspaper Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Classified * Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,936	6,801	5,937	4,426	6,497	4,944
Number of Newspaper IDs	2,086	1,961	1,576	1,454	1,628	1,507
Adjusted R-squared	0.129	0.105	0.222	0.249	0.469	0.324

Table 4:

Targeting: Effect of Craigslist Entry on Newspaper Editor Type (OLS Models)

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dependent Variable	Total Positions	Art	Business	Entertainment	Home	Local	National	Opinion	Special	Sports	Technology
Craigslist Entry	0.1114	0.0010	-0.0027	0.0037	0.0048	-0.0001	-0.0007	0.0135	0.0272**	-0.0401***	-0.0065
	[0.0943]	[0.0092]	[0.0050]	[0.0062]	[0.0062]	[0.0077]	[0.0014]	[0.0083]	[0.0133]	[0.0144]	[0.0058]
Classified	0.3224***	0.0006	0.0106**	0.0149***	0.0113*	0.0047	0.0003	0.0074	-0.0190*	-0.0288*	-0.0021
	[0.0942]	[0.0070]	[0.0046]	[0.0048]	[0.0066]	[0.0065]	[0.0010]	[0.0083]	[0.0107]	[0.0149]	[0.0055]
Craigslist Entry*Classified	0.0075	0.0067	0.0088	-0.0013	-0.0123	0.0074	0.0033	-0.0028	-0.0262	0.0114	0.0049
	[0.1468]	[0.0119]	[0.0090]	[0.0085]	[0.0105]	[0.0109]	[0.0035]	[0.0162]	[0.0161]	[0.0201]	[0.0085]
Average ISPs	-0.1926	-0.0354	0.0236*	0.0387	0.0270	0.0201	-0.0048	0.0349	-0.0582	-0.0453	-0.0006
	[0.3370]	[0.0295]	[0.0140]	[0.0255]	[0.0319]	[0.0243]	[0.0042]	[0.0315]	[0.0371]	[0.0514]	[0.0203]
Newspaper Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Classified * Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500
Number of Newspaper IDs	2,032	2,032	2,032	2,032	2,032	2,032	2,032	2,032	2,032	2,032	2,032
Adjusted R-squared	0.065	0.004	0.021	0.017	0.008	0.003	0.006	0.028	0.012	0.035	0.004

Table 5:

Robustness Check: Effect of Craigslist Entry (OLS Models)

Model	(1)	(2)	(3)	(4)
Dependent Variable	Log Classified Ad Rate	Log Price	Circ Share	Log Display Ad Rate
Number of Posts	0.0046	-0.0013	0.0000	0.0026
	[0.0048]	[0.0013]	[0.0002]	[0.0016]
Classified	0.0290	-0.0354**	-0.0043	-0.0082
	[0.0517]	[0.0158]	[0.0027]	[0.0122]
Number of Posts*Classified	-0.0158**	0.0039**	-0.0005**	-0.0047**
	[0.0072]	[0.0018]	[0.0002]	[0.0020]
Average ISPs	-0.4543*	0.0759**	-0.0436**	-0.1173**
	[0.2490]	[0.0382]	[0.0197]	[0.0532]
Newspaper Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Classified * Year Dummies	Yes	Yes	Yes	Yes
Observations	4,003	6,738	4,370	4,886
Number of Newspaper IDs	990	1,953	1,443	1,494
Adjusted R-squared	0.129	0.106	0.246	0.322

Table 6:

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

	(1)	(2)
Age	0.0009	0.0008
	[0.0006]	[0.0005]
Population	0.0010***	0.0009***
	[0.0003]	[0.0003]
Pct. College Degree	0.1404**	0.1283**
	[0.0705]	[0.0625]
Per Capita Income	-0.0585	-0.0523
	[0.0422]	[0.0370]
Pct. Rental	0.0724*	0.0685*
	[0.0382]	[0.0357]
Average ISPs	-0.0481	-0.0427
	[0.0312]	[0.0280]
Classified		0.0042
		[0.0026]
Independent		0.0038
		[0.0033]
Newspaper Age		-0.0000
		[0.0000]
Year Dummies	Yes	Yes
Observations	4,951	4,951
Pseudo R-squared	0.522	0.527

Table 7:

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

Model	(1)	(2)	(3)	(4)
Dependent Variable	Log Classified Ad Rate	Log Price	Circ Share	Log Display Ad Rate
Classified	0.0236	-0.0492**	0.0029**	-0.0190
	[0.0536]	[0.0208]	[0.0014]	[0.0144]
Eventual Entry*Classified	-0.0092	0.0147	-0.0039	0.0176
	[0.0594]	[0.0104]	[0.0032]	[0.0176]
Average ISPs	-0.4766*	0.0717*	-0.0386*	-0.0780
	[0.2487]	[0.0391]	[0.0199]	[0.0594]
Newspaper Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Classified * Year Dummies	Yes	Yes	Yes	Yes
Observations	3,853	6,099	3,885	4,372
Number of Newspaper IDs	972	1,892	1,404	1,461
Adjusted R-squared	0.1343	0.1007	0.2362	0.2676

Figure 1:

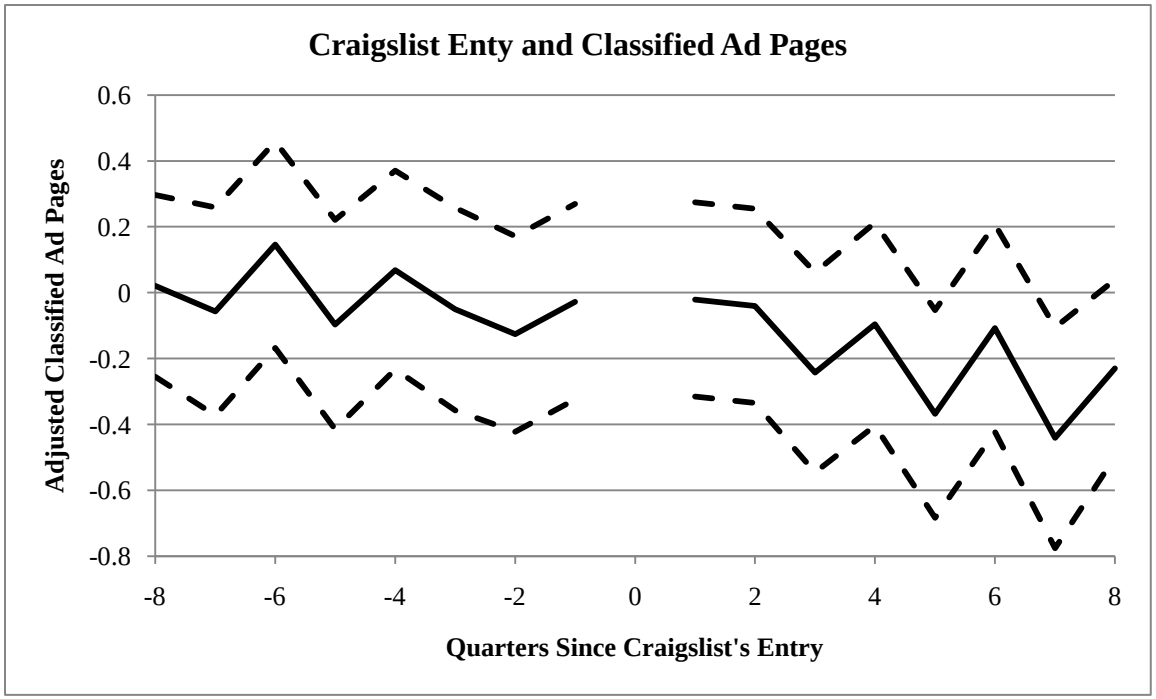
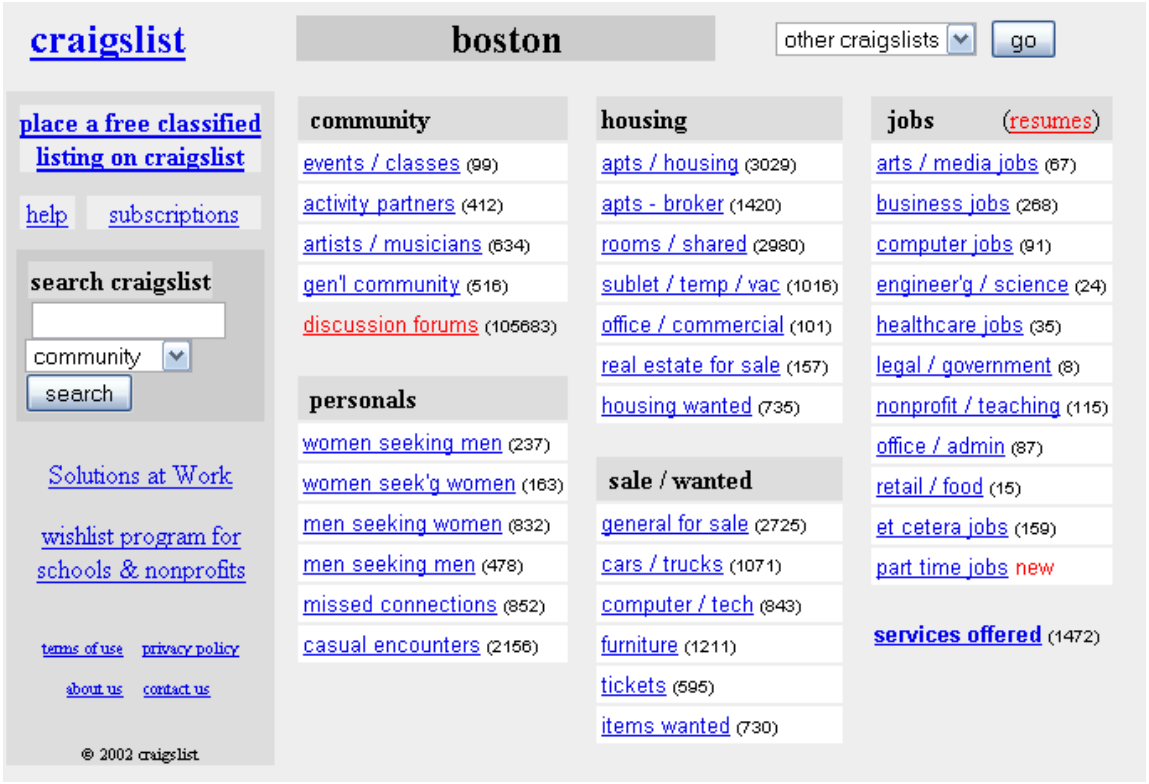


Figure 1 plots coefficients and 95 percent confidence intervals from a regression of log classified advertising pages for eleven newspapers on indicator variables for number of quarters since Craigslist's entry. Quarter of entry is omitted. Also included in the regression are log total newspaper pages, year dummies and quarter dummies. The eleven newspapers are Albany *Times Union*, *Baltimore Morning Sun*, *Cincinnati Enquirer*, *Cleveland Plain Dealer*, *Dallas Morning News*, *Denver Post*, *Detroit News*, *Houston Chronicle*, *Indianapolis Star*, *Kansas City Times-Star*, and Rochester *Democrat and Chronicle*.

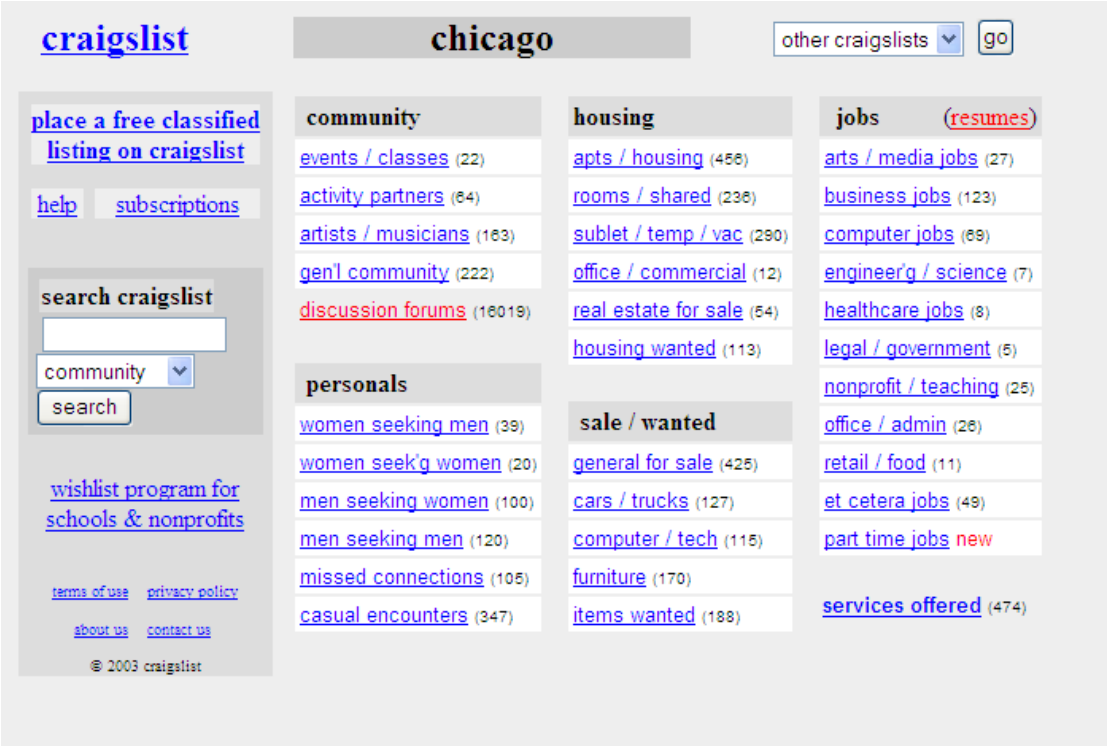
Figure 2:



Boston Craigslist from February 2003.

Source: http://web.archive.org/web/20030129082927/boston.craigslist.org/, last accessed September 29, 2010.

Figure 3:



Chicago Craigslist from February 2003.

Source: http://web.archive.org/web/20030205062029/http://chicago.craigslist.org/, last accessed September 29, 2010.