ARE BAD TIMES GOOD FOR THE INTERNET?
AN EMPIRICAL ANALYSIS OF THE SHIFT TO INTERNET ADVERTISING DURING RECESSIONS

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ABSTRACT

Internet advertising has several distinct benefits over more traditional advertising media such as television and newspapers. These include increased flexibility, cost effectiveness, targeting, and measurability. Given these advantages, it seems that internet advertising is ideally suited for times when budgets are constrained, and any marketing initiatives need to be strongly justified. This study explores whether there is a shift in the allocation of advertising expenditure towards online media as a result of recessions. A first step investigates whether the growth in internet advertising can be explained by the growth in sales in the field most closely tied to the medium: e-commerce. Next, the empirical results show that e-commerce does serve as a good baseline for explaining the growth in internet advertising, but that there is a separate, significant, and positive effect of the recession on internet advertising, both in dollar and share terms. A comparison to TV advertising expenditures shows that TV advertising does not exhibit similar behavior.

Keywords: advertising expenditure, online advertising, business cycles, internet advertising, recessions, e-commerce

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1. Introduction

Internet advertising is one of the fastest growing sectors of advertising expenditures in the U.S. According to a report by David Hallerman for eMarketer and based on data provided by the Interactive Advertising Bureau (IAB) and PriceWaterhouseCoopers (PwC), spending on internet advertising in 2008 totaled $23.4 billion, 8.7% of total advertising expenditures, up from 7.6% the previous year. Internet advertising has been growing, even though overall advertising expenditures in the U.S. fell by 1.7% in the first nine months of 2008, according to TNS Media Intelligence. In fact, total media expenditures have been falling for 4 years, an unprecedented trend since as far back as 1940. Whereas internet advertising has grown, spending on other media has decreased: analysis by ten different agencies has shown that television, radio, newspaper, magazine, and Yellow Pages advertising have fallen over the past several years (Hallerman 2009).

Internet advertising growth varies across categories. The IAB breaks internet advertising into the following types: search, display, video, rich media, classifieds, sponsorships, lead generation, and email ads (IAB 2009, p. 16). Appendix 1 provides definitions of the various types of internet advertising taken from the IAB Internet Advertising Revenue Report for 2008. Spending on mobile advertising is excluded. According to this grouping, in 2008, search ads made up the majority of advertising expenditures on online media, totaling 45% of the total. The second largest category is display ads, with a 20.8% share. Video currently makes up only 3.1% of all internet advertising expenditures.

Though search may be the most effective and measurable internet advertising format, all internet advertising has several distinct benefits over other media. With the development of tools like Google Analytics, marketers are able to gather quantitative data on how many people see
their ads, where these people are coming from and going to, including whether they proceed to purchase a product or not\(^1\). Greater measurability of ad effectiveness means that firms are able to demand more accountability for every advertising dollar spent, and marketers are able to provide those statistics. This is especially important during recessions, since as times get tougher, spending has to be increasingly justified: though estimates are possible, other forms of advertising media do not provide the same measurability.

Measurability would mean nothing, however, if changes in advertising budget allocations could not come about as a result, leading to a second distinct benefit of internet advertising: flexibility. Internet advertising is a fairly short-term media. Marketers are usually not locked into long-term contracts with internet advertising providers. Rather, marketers are free to adjust on an ongoing basis. With search advertising, for instance, marketers can get feedback on the success of their ad placements in Google search results, based on keywords people are searching for. If they determine that their current set of keywords is not providing enough revenue, they can find data on the keywords searched most often relating to their industry, and submit bids to purchase these keywords from Google via an auction. Once the keywords are purchased, any time that someone searches for those keywords, the advertiser’s listing will appear somewhere on the search result page, depending on which position the advertiser bid. Edelman, Ostrovsky, and Schwarz (2007) write that one of the unique features search advertising, which is now the dominant form of internet advertising, is that “bids can be changed at any time” (244). Google, the industry leader in search advertising also writes on its webpage, “you can change your budget

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\(^1\) Google Analytics, for instance, allows advertisers to track sales and conversions, optimize search advertising campaigns by providing “post-click data on your keywords, search queries, match type and more”. It also shows “publishers which site content generates the most revenue.” It provides tracking of all types of online ads, and allows advertisers to “trace transactions to campaigns and keywords, get loyalty and latency metrics, and identify your best revenue sources”. A full list of features can be found here: www.google.com/analytics/features.html.
and bids at any time.” The ability to adjust quickly is just one manifestation of the speed that characterizes the online world: though marketers have to work harder to keep up with quickly changing consumer preferences, the internet also enables the tracking of those changes, so that adjustments can be made and efficiency enhanced.

Internet advertising has not been widely discussed in the scholarly literature. This study partially addresses the lack of analysis of internet advertising by focusing on its response to recessions. In particular, is there a positive shift towards internet advertising as a result of recessions, controlling for other variables which can affect growth? More specifically, does the recession-specific shift towards internet advertising still exist when controlling for the recession in e-commerce?

The increasing importance of internet advertising, as well as the current economic recession, the most severe in decades, makes the exploration of questions pertaining to internet advertising’s response to recessions particularly timely, and a proper place to begin to fill in the gaps in research on a medium that is revolutionizing marketing activities.

The rest of the paper is structured as follows: Section 2 provides a review of relevant literature. Section 3 discusses the economic model that motivates the research. Section 4 presents the sources of data used for the analysis. Section 5 presents the econometric model used to perform the empirical estimation. Section 6 presents results, while Section 7 offers some concluding remarks and directions for future research.

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3 As the Congressional Budget Office writes in its “A Preliminary Analysis of the President’s Budget and an Update of CBO’s Budget and Economic Outlook” for March 2009, “For the next two years, CBO anticipates that economic output will average about 7 percent below its potential—the output that would be produced if the economy’s resources were fully employed. That shortfall is comparable with the one that occurred during the recession of 1981 and 1982 and will persist for significantly longer—making the current recession the most severe since World War II.” Source: http://www.cbo.gov/ftpdocs/100xx/doc10014/Summary.4.1.shtml.
2. Literature Review

2.1 Economics of Advertising

Since the 1970s, the study of advertising in economics has grown substantially. Survey articles, such as those by Vakratsas and Ambler (1999), and more recently, by Bagwell (2007), analyze hundreds of articles and draw out general patterns. Of this research, one aspect in particular is relevant: discussions about the function of advertisements, whether they are informative or persuasive. The persuasive view holds that advertising creates brand loyalty, thereby generating sales in the future, as well as in the present. According to the informative view,

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\text{many markets are characterized by imperfect consumer information, since search costs may deter a consumer from learning of each product’s existence, price and quality. This imperfection can lead to market inefficiencies, but advertising is not the cause of the problem. Instead, advertising is the endogenous response that the market offers as a solution. When a firm advertises, consumers receive at low cost additional direct (prices, location) and/or indirect (the firm is willing to spend on advertising) information (Bagwell 2007, p. 3-4).}
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This study will abstract from the competitive effects of both types of advertising; rather, it will use these two approaches to simplify the classification of the characteristics an advertiser must trade off between when making a media allocation decision. Also, data analysis being conducted at the aggregate level, competitive effects among firms in an industry will not be addressed.

The second aspect relevant to this study from the literature on the economics of advertising is that relating to the shape of response functions. As Lilien, Kotler, and Moorthy write, “Perhaps the most interesting set of controversies surrounds the shape of the response function […]. The most commonly discussed advertising response curve shapes, then, are concave and S-shapes. […] While a good deal of discussion and modeling concerns S-shaped response, most of the empirical evidence supports concavity” (Lilien, Kotler, Moorthy 1992, p.
Though the research on advertising response functions has not provided conclusive evidence of one curve shape over the other, this study will be assuming a concave advertising response function to simplify the analysis.

Another relevant aspect of the economics of advertising has to do with models of media selection. Lilien, Kotler, and Moorthy (1992) provide a good overview of models seeking to find the optimal media mix to use given certain objectives, such as achieving a certain level of brand-awareness. Much of the research in this field focuses on identifying the effect of ad exposures on brand-awareness by estimating the reach, frequency, and impact of an ad exposure. The authors define reach, frequency, and impact in the following way:

Reach \((R)\): the number of different persons or households exposed to a particular media schedule at least once during a specified time period.

Frequency \((F)\): the number of times within the specified time period that an average person or household is exposed to the message

Impact \((I)\): the qualitative value of an exposure through a given medium (p. 307).

Though modeling each of these aspects outright is not the focus of this research, these factors will enter into the analysis of the productivity of an advertising medium.

### 2.2 Endogeneity in Modeling the Sales-Advertising Relationship

The relationship between sales and advertising is one of the most debated topics in the literature of advertising in economics. There is a vast literature and a long-lasting debate in econometrics pertaining to the endogeneity concerns inherent in modeling sales and advertising, specifically addressing which way causality runs: from sales to advertising or vice versa. A literature review of the topic by Berndt (1991) arrives at the conclusion that given the lack of conclusive proof regarding causality between sales and advertising one way or the other, “For the moment, however, it is safest to assume that causality occurs from aggregate consumption to
aggregate advertising but does not occur in the reverse direction” (p. 400). This issue arises in the analysis described in later sections.

2.3 Advertising Expenditures and Recessions

The economics of advertising research focuses on the role of advertising, consumer reactions to it, and its impact on firm decisions, such as price-setting. Missing from these surveys is the connection between advertising and the business cycle. As Picard states in the introduction to his paper, “Even books focusing on advertising economics have tended to focus on the economic effects of advertising, not the effects of the economy on advertising” (Picard 2001). In recent years, papers have emerged that grapple with the interrelationship between advertising expenditures and recessions, though they are still few in number. Though several of these studies examine differences across media, internet advertising is not addressed, most likely due to the lack of sufficient data available at the time these studies were produced.

The papers dealing with the connection between advertising and business cycles can be divided into two categories: the first attempts to derive marketing strategies that firms can implement to weather recessions (Pierce II and Michael, 1997; Frankenberger and Graham 2004; Srinivasan, Rangaswamy, and Lilien 2005); the second deals with advertising expenditure’s response to recessions, the topic to which this study is seeking to contribute (Picard 2001; Chang and Chan-Olmsted 2005; Deleersnyder, Dekimpe, and Leeflang 2007). Within this second category, there is a subcategory devoted to the “principle of relative constancy,” often referred to as PRC. PRC tries to relate changes in overall economy measures such as GDP and GNP to advertising expenditures to see whether expenditures are a constant proportion of these measures across time.
Even within the different categories relating advertising expenditures to recessions, the studies seek to answer different questions. In the marketing strategies category, for instance, Pierce II and Michael examine the behavior of small entrepreneurial firms, while Srinivasan, Rangaswamy, and Lilien find results relating to large, established firms. Frankenberger and Graham do not focus their attentions on any particular types of firms, but rather examine several thousand different firms across a variety of industries.

Within the advertising response to recession category, the emphasis is placed on differing aspects. For instance, Picard seeks to explain advertising expenditure’s response to recessions across developed countries and across media. Deleersnyder, Dekimpe, and Leeﬂang extend Picard’s exploration into numerous other countries, and attempt to explain cross-country differences. Chang and Chan-Olmsted also focus on identifying national characteristics across numerous countries that affect advertising, though unlike Deleersnyder, Dekimpe, and Leeﬂang, they focus primarily on examining the “principle of relative constancy”.

Many of the papers discussed above cite similar sources, including research on the “principle of relative constancy” by McCombs 1972, McCombs & Eyal 1980, McCombs & Nolan 1992, Son & McCombs 1993, and Wood 1986. Also, the papers by Picard (2001) and Srinivasan, Rangaswamy, and Lilien (2005) are themselves cited by several of the works under discussion. Since the exploration of advertising expenditures’ response to recessions is a relatively new area of research, these pieces serve as the seminal works for those contributing to the field.

To obtain their results, Pierce II and Michael (1997) examine marketing activities and financial performance of each company in their sample throughout the business cycles. They elicit data on marketing activities by way of a survey sent to 452 publicly traded manufacturing
firms in specific industries, whose annual sales in 1990 were between $10 to $100 million. All firms operate in a single industry, so results are unaffected by firms that diversify. These firms were classified by Standard & Poor to be in industries that were highly innovative and technologically demanding. Also, each company was small, with a maximum market share of 0.5%, so that it could be said that these qualified as entrepreneurial firms. Also, all of the firms in the sample were in high-growth industries. The response rate for the surveys was 23.9%. The authors ran tests to check for nonresponse bias, as firms that did poorly might be more embarrassed to reveal information; the tests showed no significant difference between responding and non-responding firms. The surveys were carefully crafted to be as precise as possible and to avoid possible biases. Executives ranked marketing activities on a Likert-type scale, ranging from “1” (no emphasis) to “5” (great emphasis). The information they gathered on financial performance, such as data on return on equity, was obtained for the entire business cycle from the third quarter of 1989 to the first quarter of 1991 from Standard & Poor’s Compustat Financial Data Base on U.S. Companies. Since many of the questions on the survey were correlated, the authors grouped questions into four factors: Improve Marketing Efficiency, Streamline the Value Chain, Retrench into Core Business, and Expand into New Markets.

In testing their hypotheses, Srinivasan, Rangaswamy, and Lilien (2005) first conducted field interviews with 20 senior marketing executives across 12 organizations to develop a structure for their survey. They then mailed 1200 surveys, 154 of which were returned, for a response rate of 14%, which is standard for studies of this sort. The measures developed by the authors were pretested on MBA students. The resulting measure was a nine point scale for proactive marketing. Different scales were designed to measure strategic emphasis on marketing, entrepreneurial culture, availability of slack resources, severity of recession, and business
performance. The authors performed a multitude of tests to ensure the robustness of their method, and found them to yield satisfactory results. Their findings suggest that firms that engage in proactive marketing do better during and after recessions, though the firms that can benefit most strongly are those that already have a strong emphasis on marketing and high brand-recognition. More detailed results are provided later in the section.


Though most of the papers under discussion use regression analysis (time-series or simple) to analyze their data, Picard (2001) uses only correlation analysis, since he claims that the goal of his research is exploratory and that the eight year period is too short to allow for more rigorous statistical analysis. He then ranks correlation on a five-part scale from slight to very high, and makes conclusions based on the rankings. Srinivasan, Rangaswamy, and Lilien (2005),
too, rank their variables on scales and base their results on the results of their rankings. Unlike Picard, however, they do not use one scale to rank all variables; rather, they develop separate scales appropriate to each variable they examine, as mentioned previously.

Though Pierce II and Michael (1997) also conducted a survey to obtain their data, much like Srinivasan, Rangaswamy, and Lilien (2005), they use simple multiple regression analysis to obtain their results. They set up a regression whereby return on equity serves as the dependent variable; this is an apt measure of performance since management has to focus on the interests of shareholders. Also, return on equity controls for capital structure. The authors then compare performance for two time periods: the peak (Q3 1989 – Q2 1990) and contraction (Q3 1990 – Q1 1991) of the economy. The four major factors emerging from their surveys serve as independent variables in the partial model, used to identify the main effects. Interaction terms are also included in the model. Results from the peak and contraction periods are shown to be statistically significantly different from one another.

Chang and Chan-Olmsted (2005) use two different methods of analysis to test for the principle of relative constancy: static and dynamic. In the static setting, cross-sectional data are used to determine whether GDP is really the only significant explanatory variable affective advertising expenditures, or if the other variables also play a role in its determination. The other variables account for characteristics across countries, such as population, economic openness, economic freedom, and press freedom. The dynamic setting tests for the time component of the PRC: whether advertising expenditure is constant over time. It also examines whether constancy is found across countries. The second model relates advertising spending to GDP and time variables. The authors use correlation analysis, as well as simple and multiple regression analysis
to test these models. In interpreting the correlation results, the same five-part scale used by Picard (2001) is employed.

Unlike the preceding papers, Deleersnyder, Dekimpe, and Leeflang (2007) use more sophisticated time series regression modeling to analyze their data. The methodology for obtaining results involves three steps: first, the cyclical component of each series is filtered out, using a modified Hodrick and Prescott (1997) filter, which allows for structural breaks in the series, such as the introduction of TV in several countries during the span of the data. They set up equations for the trend and slope, which allow for a shift in the level of the series and a change in the slope. The trend component is then subtracted from the series to isolate the business-cycle component. The second step of the estimation involves estimating the cyclical co-movement of advertising with respect to the economy, as measured by GDP. The third and final step of the estimation involves testing for cross-country variation in the degree of cyclical sensitivity of advertising expenditures. The authors estimate the impact on four media: magazines, newspapers, radio, and television. To control for variation across continents, five dummy variables are included, one for each continent. North America serves as the reference group. Generalized Least Squares is used to account for the possibility of dependence among observations from the same country. Using a White test, the authors find that heteroskedasticity is not an issue.

Frankenberger and Graham (2004) also use cross-sectional time-series regression techniques to obtain their results, though the exact method is not discussed. The only statement referencing the setup of their equations is that “They analyze the economy-wide and industry-specific effects that average advertising spending has on earnings and market value, and compare
those effects with the effects of increased and decreased advertising spending during recessionary periods” (9).

Though his method of correlation analysis may not be the most robust, Picard (2001) finds that the relationship between advertising expenditures and recessions varies across countries. Some countries exhibited high correlations between advertising expenditures and downturns in the economy, while others exhibited only moderate or small correlations. Chang and Chan-Olmsted report similar findings: there is a lot of variation across countries in the relationship between advertising expenditures and GDP. Deleersnyder, Dekimpe, and Leeflang too find that there is a large variation across countries in terms of advertising’s percentage share of GDP. They also find that most of the co-movement elasticities across countries are positive, meaning that advertising is pro-cyclical. Picard’s study finds that, on average, a decrease of GDP of around 1% lowers advertising expenditures by an average of 5-7%, depending on the GDP calculation used. Also, an interesting result is that the drop in advertising expenditures slows as the recession deepens. Deleersnyder, Dekimpe, and Leeflang explicitly calculate the elasticity of advertising expenditures with respect to business cycles, and find that the average elasticity is greater than 1, so that overall, advertising can be said to be elastic with respect to business cycle movements. The average and median values are around 1.4. The U.S., which is the largest advertiser, has elasticities higher than those of other countries.

In terms of different media, Picard finds that newspaper and magazine advertising expenditures declined by anywhere between 16-21% on average, depending on the specifications, whereas electronic media like television and radio only lost between 4-12%, depending on specifications. With regards to various media, Chang and Chan-Olmsted find that advertising expenditure is greatest on TV, with 30.1% of total expenditure, with newspapers,
magazines, radio, outdoors, and cinema following respectively. Also, they find significant
correlations among the different advertising subcategories. Deleersnyder, Dekimpe, and
Leeflang, too, find that spending on media varies across countries, with newspapers and
television vying for the top two spots of the media analyzed. Of all media, they conclude that
only radio has an elasticity not significantly greater than 1. Magazine and newspaper spending is
more sensitive to business cycles than television, they conclude, which in turn, is more sensitive
than radio, a result in line with Picard’s finding discussed earlier.

Regarding variables controlling for national characteristics, Chang and Chan-Olmsted
find that of all the variables, GDP was strongly related to total expenditures. The other variables
were insignificantly related to either total or subcategory expenditures. Deleersnyder, Dekimpe,
and Leeflang (2007) also examine cross-country differences and find that advertising
expenditures in Asia, Europe, and South America are more elastic than in North America,
Oceania, and Africa.

Regarding the principle of relative constancy that Chang and Chan-Olmsted set out to
explore, much like previous studies on the topic, the authors find mixed results: the principle of
relative constancy does not hold when total, radio, and newspaper advertising expenditures are
considered, so that the proportion of GDP attributed to advertising expenditures is not constant
across nations. The constancy does hold when TV, magazine, cinema, and outdoor expenditures
are considered. In the dynamic setting, the authors found that countries with a higher correlation
between total advertising expenditures and GDP had a higher degree of economic freedom.
Some additional comparisons revealed that the countries that satisfied the principle of relative
constancy experienced higher economic and press freedom, as well as economic openness.
As for the studies examining marketing strategies that firms can implement to survive recessions, Srinivasan, Rangaswamy, and Lilien find that some firms engage in proactive marketing during a recession; those that do perform better even throughout the recession. However, a firm’s decision to engage in proactive marketing is dependent on characteristics of the firm, such as existing strategic emphasis on marketing, an entrepreneurial culture, the possession of slack resources, and the ability to be flexible about how to allocate those resources, so that not all firms can or should do likewise. Primarily firms that already place a high value on marketing activities, and possess highly recognizable brands and products can benefit from proactive marketing during a recession. These findings are in accordance with those found by Pierce II and Michael almost ten years prior, which find that in contrast to existing views, rather than simply cutting back on expenditures, a firm that wants to survive the recession needs to invest in marketing activities. Marketing activities may include increasing sales and advertising at the start of a recession, and focusing on marketing efficiency at its peak.

Finally, the study conducted by Frankenberger and Graham also emphasizes advertising’s ability to contribute to the financial success of a firm for as much as three years following the investment. Increasing advertising expenditures during a recession benefits firms even more than an increase during good times. Much like Srinivasan, Rangaswamy, and Lilien, they qualify the result by acknowledging that the effects vary, in this case by industry: consumer and industrial products companies experience an increase in performance for the recession and even for a year following, while firms in the services industry do not see an increase. Furthermore, decreasing advertising expenditures during recessions only hurts industrial products firms, and only for the duration of the recession. As a general rule, however, the authors recommend that firms maintain their advertising expenditures if possible, since advertising can be viewed as an asset in which
investment yields positive returns. For some industries, increasing expenditures makes sense, while for others it does not. Finally, those who do decide to decrease advertising expenditures will not suffer serious setbacks once the recession is over.

In conclusion, several general patterns emerge from the studies discussed in this section: first, advertising expenditures tend to move with changes in the economy, and second, investing in advertising during recessions can benefit a firm, contrary to the generally accepted notion that retrenchment is a necessary response to tough economic conditions.

3. Economic Model

The review of the literature pertaining to advertising spending during recessions has shown that overall, advertising is procyclical, and has a co-movement elasticity greater than 1. This implies that as the economy declines during recessions, advertising expenditures decrease. Interestingly enough, according to the studies discussed in the previous section, magazines and newspapers, which are considered to be more informative advertising media, had higher elasticities than TV and radio, which are considered to be more brand-building media. These studies, however, did not take into account internet advertising, which provides advertisers with more capabilities than traditional informative and persuasive media. Given the advantages internet advertising provides over other media, this study hopes to explore whether internet advertising behaves similarly or inversely to other media during recessions.

Though internet advertising is best classified as informative advertising, with only limited (but growing) brand-building capabilities, the medium has some distinct benefits over other informative, and even brand-building, media. One of the main benefits internet advertising provides is more measurable results. Using internet advertising, advertisers can track not only click-through and conversion rates, but even the pattern of mouse movements over an ad; they
can tell who has looked at and clicked on an ad, as well as who has made a purchase, having
followed the ad to the specified link. Moreover, due to the large amount of detailed, specific data
available for each individual ad, an advertiser can estimate the sales conversion rate precisely.

Though internet advertising may not afford as much brand-building capability as more traditional
broadcast media, such as TV and radio, in the short-run, internet advertising provides more
certainty. It is possible to measure conversion rates from TV and radio advertising; the methods,
however, are much more imprecise and difficult to implement. Also, the resulting data would
contain a lot of noise. In essence, internet advertising generates sales for certain, though only in
the short-run. Brand-building advertising, on the other hand, may generate more sales overall,
but spread over multiple periods and incapable of being measured with the same degree of
precision.

The measurability afforded by internet advertising is especially valuable during times of
high uncertainty, such as those characterized by an economic downturn or recession. Given that
people are risk-averse, recessions that are characterized by high uncertainty and risk would lead
people to place even more weight on knowing an outcome for certain. This leads to the
prediction that internet advertising should do relatively well during recessions. After all, the
benefits of internet advertising seem better suited for bad economic conditions when budgets are
reduced and more accountability is required: internet advertising provides advertisers with more
immediate sales than brand-building media and the ability to measure ad effectiveness on a
detailed basis, enabling higher accountability for every dollar spent. When the future is
uncertain, sales in the present gain in importance relative to sales in the future. Therefore, current
sales generated by a measurable medium such as internet advertising are valued relatively more
than potentially greater sales generated by brand-building advertising in the future. The more
immediate impact, higher measurability, and consequent certainty internet advertising provides suggest that recessions will likely trigger a relative, and possibly even absolute, shift towards internet advertising.

In economic terms, the tradeoffs involved in the online advertising investment can be thought of using a simple economic model; suppose an advertiser only has two media from which to choose: a brand-building medium, such as TV, and an informative medium, such as internet advertising. The two media are substitutes, though not perfect substitutes. For simplicity, this model assumes that there are only two periods of time: the current period, period 1, and a future period, period 2. The sales-response function for each medium is assumed to be concave, as discussed in the literature review. Therefore, both types of advertising exhibit diminishing returns. The only difference between sales generated by brand-building advertising and internet advertising is the timing: internet advertising generates sales only in period 1, while brand-building advertising generates fewer sales in period 1, but additional sales in period 2, for greater total sales. The sales response functions are presented in Graphs 1 and 2.
The allocation between media is chosen based on reasoning similar to that governing the capital-labor input decision in standard production theory. When plotting brand-building advertising against internet advertising, the result is a standard isoquant-isocost graph. In this case, the isoquant represents a constant quantity of sales generated by various combinations of the two media. The isocost represents a constant level of cost produced by combinations of the two advertising media. The optimal point will be where the bang-per-buck of each medium is the same; more formally, this can be expressed as

\[
\frac{MP_B}{P_B} = \frac{MP_{Net}}{P_{Net}}
\]

, where
- \(MP\) = marginal productivity
- \(P\) = price
- \(B\) = brand-building advertising
- \(Net\) = internet advertising
The equilibrium point is labeled as X in Graph 3 below. At this point, relatively more is spent on brand-building advertising, due to its greater productivity in generating total sales, both current and future.

Now economic conditions enter into the picture. This model assumes that there are only two states of the world: good and bad economic conditions. Bad economic conditions mean that there is a recession in the economy. One of the effects characterizing a recession is an exogenous demand shock in the economy, thereby reducing consumer willingness to purchase and driving down revenues for firms. As revenues decline, there is less money available to be allocated to all divisions, and therefore, cutbacks are instituted across the board. This cost-containment effect would imply that the advertiser would shift away from the equilibrium point to a lower isocost line. If this was the only effect and there was no change in the curvature of the isoquant, it would imply that spending on both media decreases, while the relative shares remain the same (see
Graph 4). The new equilibrium would be at point Y. This does not take into account, however, the relative benefit afforded by internet advertising. This model assumes that there is perfect information and that each medium is equally measurable. In reality, this is not the case: internet advertising has a distinct advantage in terms of measurability over other forms of advertising.

**Choice of Advertising Media Allocation**

![Choice of Advertising Media Allocation Diagram]

**Brand-Building Advertising**

A more likely scenario is that the recession also causes the sales generated by brand-building advertising in period 2 to be less than anticipated initially, so that the medium becomes less productive in its future impacts. Assuming for now that prices do not change, as brand-building advertising becomes less productive and profits fall, the advertiser substitutes towards the more productive medium, internet advertising. It is more productive since it generates more immediate, certain sales, which are highly valued during times of uncertainty. This reasoning assumes that prices are not affected by the recession, though this does not seem like a realistic assumption. It is more likely that all four variables in the equilibrium condition undergo changes
during a recession; prices for both media most likely decrease, while the marginal productivities also experience changes. This makes it difficult to disentangle the impact of the recession on media allocation. By analyzing the effects of both an unanticipated and anticipated recession, it is possible, however, to make certain logical conclusions regarding the direction of change.

In the case of an anticipated recession, the advertiser knows at the start of period 1 that there will be a recession at the start of period 2. Spending on internet advertising will not be affected in period 1, since all of the sales generated by the medium are realized within that period and before the recession hits. Spending on brand-building advertising, however, will decrease even in period 1, since the sales generated by the medium in period 2 will be less as a result of the demand shock in the economy. Therefore, the investment in brand-building advertising generates a smaller return in period 2, decreasing its productivity, and leading to less initial investment in period 1. Given that brand-building advertising is less productive, it is likely that there will be a relative, and perhaps even absolute, shift towards internet advertising, which is now relatively more productive. The magnitude of that shift, however, may be fairly minor.

In the case of an unanticipated recession, the recession occurs at the start of period 1. Given that demand falls, so that the same amount of advertising generates fewer sales, it is reasonable to expect that spending on both media falls: both are now relatively less productive in generating sales. Due to the measurability benefit afforded by internet advertising, however, the advertiser would most likely increase the share of internet advertising, since it will allow for more accountability and will generate a more certain amount of sales than brand-building advertising. Moreover, since recessions are usually expected to last at least until the next period, brand-building advertising is decreased further, because as discussed, its future productivity is
harmed. Internet advertising, on the other hand, will not suffer from this effect. In both cases, then, there is reason to believe that a shift towards internet advertising will occur.

Graphically, the recession causes the isoquant to shift out and twist (see Graph 5). The shift outwards is caused by the demand shock component, which means that for any given level of advertising, fewer sales are realized; therefore, in this model, more of all advertising is needed to attain the same amount of sales as during good economic conditions. The twist occurs because of the fall in the productivity of brand-building advertising, as discussed above, and the resulting shift towards internet advertising, the relatively more productive medium.

### Choice of Advertising Media Allocation

![Graph 5](image)

**Brand-Building Advertising**

Another way of looking at the increased relative productivity of internet advertising is to consider the timing of revenues. In this simple model, internet advertising provides revenues only in period 1; therefore, there are no future cash flows to be discounted. Brand-building advertising, on the other hand, provides revenues in periods 1 and 2; due to the time value of
money, the cash flows in period 2 are discounted by a factor equivalent to $1/(1+r)$, where $r$ is the discount rate. This factor will be referred to as $\delta$. The following equation summarizes this concept:

$$PV \text{ of Benefits Generated by Spending on Brand-building Advertising} = R_1 + \delta R_2$$

where

$R_i$ = revenues generated by brand-building advertising at period $i; i=\{1,2\}$
$\delta$ = discount factor=$1/(1+r)$
$r$ = discount rate.

During a recession, there is higher uncertainty and volatility, leading to more risk. The higher risk manifests itself in the desire on the part of most organizations to shift cash flows from the future to the present. The added cash flows will help the firm weather the recession and provide some certainty of revenue in an uncertain economic environment. In economic terms, the higher risk contributes to a higher discount rate, since cash flows in the uncertain future are worth less than cash flows today. In examining the present value of the cash flows generated by brand-building advertising, this means that the cash flows in period 2 are worth less in period 1. In addition, given the drop in sales during the recession, and assuming that prices either stay the same or fall, there is a decrease in period 2’s revenues. Combined with the discount rate increase, the decrease in revenues magnifies the present value drop of a brand-building advertising investment. A lower present value means that the same investment in brand-building advertising generates fewer benefits, reinforcing the notion that there should be a drop in spending on the medium.

As brand-building advertising becomes less productive, the isoquants change shape and shift outwards, resulting in a new equilibrium point. The new optimum will depend, however, on which strategy the advertiser chooses to take. If the advertiser chooses to spend the same amount
on advertising, the optimal point lies on the same isocost line as before. In this case, however, the tangent isoquant curve represents a lower amount of sales, since to generate the same amount of sales, the advertiser needs to spend more. In addition to the fall in sales, there is a shift towards internet advertising, since it is now more productive; this is captured graphically by a flattening of the isoquant, so that it is tangent to the isocost at a higher level of internet advertising (see Graph 6). The new optimal point is labeled as W.

Choice of Advertising Media Allocation

Brand-Building Advertising

Graph 6

Another possible case is that the advertiser is determined to match previous sales, so that rather than shifting to a lower isocost, he shifts to a higher one that is tangent to the original isoquant. Even in this case, however, there is a twist in the isoquant as he substitutes towards the more productive medium (see Graph 7). The result is a higher level of spending, the same level of sales, and a shift towards internet advertising. The new optimal point is labeled as V, though
the large magnitude of the effect is used for illustrative purposes only. In reality, the shift may be very minor.

Even though it seems that advertising should increase to try to rouse demand and increase sales, as discussed in the literature review, a more common reaction of firms to bad economic conditions is to retrench, or cut back. This is in accordance with the first recession effect discussed: lower revenues lead to a need for cutbacks across all units in an organization, leading to a shift inward in the desired isocost line. In this case, there is a decrease in advertising, as the advertiser moves to a lower isocost line, as well as a strong decrease in sales generated; sales are lower even at the original isocost, so that if the isocost is shifted inwards, there is an even sharper drop in generated sales. Once again, since internet advertising is more productive, there is a flattening of the isoquant, and a relative share increase of internet advertising (see Graph 8). The new optimum is labeled U.
In summary, this model predicts that though more might be spent on brand-building advertising because of its future generated sales, recessions would lead to a shift towards internet advertising. The shift would occur because of two aspects of internet advertising: immediate sales generation, and higher measurability, resulting in more certain sales. Therefore, if $\alpha_{TV}$ is the share spent on TV advertising and $\alpha_{Net}$ is the share spent on internet advertising, the model predicts the following:

$$\alpha_{TV} > \alpha_{Net}$$

$$\alpha_{TV, G} > \alpha_{TV, B}$$

$$\alpha_{Net, G} < \alpha_{Net, B}$$

where

G = good economic conditions
B = bad economic conditions.
Though this analysis was conducted at the individual firm/advertiser level, data on firm-specific expenditures is not currently available at the level of detail desired. Therefore, this study will assume that the sum of the individual spending decisions is equal to the aggregate spending on advertising, and will conduct empirical estimation at the aggregate level.

4. Data

4.1 Data Sources

Based on the economic analysis described in the previous section, this study set out to examine whether the predicted shift towards internet advertising during recessions existed. To this end, the collection of data revolved around internet advertising expenditures and e-commerce sales, in both dollar and share terms, as well as several other variables, such as TV advertising expenditures and total retail sales. The justifications for the use of this data will be discussed in the Econometric Model section.

Data on internet advertising expenditures spanning 1997Q1 to 2009Q2 were taken from the Interactive Advertising Bureau’s (IAB) Internet Advertising Reports. According to the IAB, “The IAB’s Internet Advertising Revenue Report, a survey conducted independently by PricewaterhouseCoopers, is released in full twice a year, to coincide with the collection of half-year and full-year data. [...] The results reported are considered the most accurate measurement of Internet/online advertising revenues since the data is compiled directly from information supplied by companies selling advertising online. All-inclusive, the report includes data reflecting online advertising revenues from Web sites, commercial online services, Email providers, as well as other companies selling online advertising.” The reports cover all internet advertising formats, including display advertising, search, sponsorship, e-mail, lead generation,
classifieds and auctions, rich media, and digital video commercials, the definitions of which are provided in Appendix 3.

Quarterly e-commerce sales numbers were taken from the Census Bureau’s E-Stats Quarterly Retail E-Commerce Sales Report for the 2nd quarter of 2009. The seasonally unadjusted dataset was used, as seasonality was controlled for as part of the estimation. The data provided in the report is based on the Monthly Retail Trade Survey and administrative records collected by the Census Bureau. According to the Census Bureau, “E-commerce sales are sales of goods and services where an order is placed by the buyer or price and terms of sale are negotiated over an Internet, extranet, Electronic Data Interchange (EDI) network, electronic mail, or other online system. Payment may or may not be made online.”

The recession dummy was constructed using official recession dates from the National Bureau of Economic Research. During the time period covered by the data, the two major recessions that took place were from 2001Q1 to 2001Q4, as well as from 2007Q4 until the present, though data only up to 2009Q2 was used.

To calculate the share of internet advertising, data was obtained on quarterly total advertising spending from 1997Q1 to 2009Q2 from the Ad$spender database provided by TNS Media Intelligence. The total advertising measure was a sum of spending on multiple media, which are listed in Appendix 4. (The appendix also provides a link to a more detailed methodology for data collection.) The total advertising measure did include internet advertising, but data on internet advertising was only available starting in 2001 and the measure did not include search. Since search is now almost 50% of all internet advertising spending, this would have greatly understated the share of internet advertising. Therefore, the internet spending measure provided by Ad$spender was subtracted from the total advertising measure, and replaced
with internet advertising expenditure data from the IAB, as discussed earlier in this section. The share of internet advertising is a fraction of this updated total spending variable, multiplied by 100 to convert the data to percentage terms.

The Ad$spender database also provided data on quarterly TV advertising for 1997Q1 to 2009Q2. Ad$spender provides data on multiple subcategories of each advertising medium, which are mutually exclusive and can be aggregated to obtain a total measure. Therefore, the sum of expenditures on Network TV, Spanish Language Network TV, Cable TV, Syndication, and Spot TV is equal to total spending on TV advertising.

Retail sales data was obtained from the same source as the e-commerce sales data: the Census E-Stats Quarterly Retail E-Commerce Sales Report for the 2nd quarter of 2009. Once again, the seasonally unadjusted dataset was used, as seasonality was controlled for as part of the estimation. The data provided in the report is based on the Monthly Retail Trade Survey and administrative records collected by the Census Bureau. A link to the Monthly Retail Trade Survey is provided in Appendix 2.

Finally, e-commerce share of total retail sales was also obtained from the Census E-Stats Quarterly Retail E-Commerce Sales Report for the 2nd quarter of 2009. The share of e-commerce is equal to e-commerce sales divided by total retail sales and multiplied by 100 to convert into percentage terms.

4.2 Empirical Rise of Internet Advertising

Internet advertising has a strikingly linear growth over time (see Fig. 1). The exception to the linear trend of internet advertising is the period of the dot com boom and bust from 1999Q2 to 2002Q3. From 1999Q2 to 2000Q4, which can be described as a period of “irrational exuberance,” expenditures on internet advertising were above what was justified at that point due
to the optimism characterizing the dot com boom. The period of “irrational exuberance” was followed by a period of strong decline from 2001Q1 to 2002Q3 with the burst of the dot com bubble.

Though fascinating, the linear rise of internet advertising is problematic for modeling purposes. Due to the literature discussed previously on the pro-cyclicality of advertising with respect to GDP, as well as the principle of relative constancy regarding advertising and GDP, GDP seemed like a natural first choice to begin to explain the growth in internet advertising. Drawn from the Bureau of Economic Analysis, the quarterly nominal GDP data, seasonally adjusted at annual rates, was plotted over time (see Fig. 2). An examination of the graph, however, revealed that GDP too was quite linear.

The linearity of both GDP and internet advertising expenditure could contribute to a high fit of a regression estimating the impact of one on the other; this would reveal nothing, however, of the causes of internet advertising growth. On the contrary, linearity would be a confounding factor in interpreting the results of the estimation. Rather than continuing to look at GDP as an explanatory variable, of which internet advertising constitutes only a tiny fraction, this study examined a more specific sales variable. The problem of linearity, however, entered into the formulation of the empirical model described in the following section.

5. Econometric Model

5.1 Goals

Motivated by the model described in Section 3, the empirical analysis sought to answer the questions below. E-commerce was used as the relevant sales variable, reasons for which will be discussed further in the section.

- Is the growth in internet advertising due to the growth in sales in its particular field?
If so, by controlling for the recession in e-commerce, is the impact of the recession on internet advertising eliminated? Or is there a separate and significant effect of the recession on internet advertising expenditures apart from the effect on e-commerce?

If there is a significant impact of the recession on internet advertising apart from the effect on e-commerce, does the effect impact internet advertising in a positive or negative direction? Given the benefits of measurability and flexibility that internet advertising affords and the model presented, a positive effect might be expected.

A related point that was be considered in the research was whether by controlling for the effect of a linear time variable on e-commerce sales, the significance of that variable in the internet advertising specification disappears. This aspect of the analysis is summarized in the following questions:

Is the linearity in internet advertising growth driven by the linearity in e-commerce, which then affects internet advertising? Or is a linear time variable still significant in internet advertising even after including it in the estimation of e-commerce?

Since part of the economic analysis regarded the share of internet advertising spending as a fraction of total advertising, this study addressed the same questions regarding the share of internet advertising as a fraction of the total, rather than internet advertising spending in absolute terms. The primary goal of this was to see whether the main results regarding the recession impact of the initial estimation still hold; therefore, the linearity aspect was not addressed in this estimation. Finally, though this study did not develop a full model of TV advertising spending, it asked the same questions of TV advertising, using total retail sales, rather than just e-commerce sales, as an explanatory variable; this provided a comparison point to internet advertising
behavior, allowing an examination of whether the recession effect is the same across media, or whether internet advertising is indeed different.

5.2 Empirical Model

The econometric model used to answer all of the questions above is fairly simple. The empirical method was two-stage least squares, allowing for the simultaneity between advertising and sales. The first step regressed an e-commerce sales variable on a linear time variable, a seasonal dummy for Q4, and a recession dummy. Q4 was used, since the holiday season often has a strong effect on sales as purchases increase dramatically. Also, the Q4 and recession dummies were multiplied by the linear time variable: this ensured that the effects are scaled over time, rather than being of the same magnitude at every occurrence. The first stage of the estimation took the following form:

$$
\text{Predicted Total E-Commerce Sales} = a_1 + a_2(\text{Quarters Elapsed}) + a_3(\text{Q4*Quarters Elapsed}) + a_4(\text{Recession*Quarters Elapsed})
$$

(1)

The predicted values from this regression were then used to predict internet advertising spending, as follows:

$$
\text{Internet Advertising Spending} = b_1 + b_2(\text{Q4*Quarters Elapsed}) + b_3(\text{Recession*Quarters Elapsed}) + b_4(\text{Predicted Values for Total E-commerce Sales})
$$

(2)

To test for the impact of a linear time variable on internet advertising spending after controlling for e-commerce sales, another specification was also estimated, taking the following form:
Internet Advertising Spending = \( c_1 + c_2(Quarters\ Elapsed) + c_3(\text{Fitted Values for Total E-commerce Sales}) \)

In interpreting the results, the significance and the sign of \( b_3 \) were of particular interest. This coefficient determines whether recessions contribute to an increase in online advertising spending when controlling for other variables. \( c_2 \) also requires a closer look, as it holds the answer to the question of whether the significant impact of a linear time variable persists even after controlling for the variable in e-commerce.

Since internet advertising exhibited a large increase during the dot com boom, as discussed in the data section, this study also estimated a specification controlling for the effect of “irrational exuberance”. To do this, a dummy was created, which took the value 1 for all of the periods leading up to the 2001 recession, and 0 otherwise. The resulting equation took the following form:

\[
\text{Internet Advertising Spending} = d_1 + d_2(Q4*Quarters\ Elapsed) + d_3(\text{Recession*Quarters Elapsed}) + d_4(\text{Predicted Values for Total E-commerce Sales}) + d_5(\text{Irrational Exuberance})
\]

Since the period of irrational exuberance was followed by a prolonged drop in internet advertising expenditures, another stage estimated Equation (2) using data only from 2002Q1 onwards, thereby eliminating one of the recessions in the dataset. This allowed for a sensitivity analysis of the results from the main estimation in Equation (2).

Though the primary goal of the analysis was to examine spending in absolute terms, the empirical estimation also included the same equations with the share of internet advertising as the dependent variable in the second-stage estimation. This was done to determine whether the
main results from the previous estimation held; for instance, did the recession have a significant, positive impact on the share of internet advertising? The first-stage estimation took the following form:

\[
\text{Predicted E-Commerce Share of Total Retail Sales} = e_1 + e_2(\text{Quarters Elapsed}) + e_3(Q4^{*}\text{Quarters Elapsed}) + e_4(\text{Recession}^{*}\text{Quarters Elapsed})
\]  

(5)

The predicted values from this regression were then used to predict internet advertising share, as follows:

\[
\text{Internet Advertising Share of Total Advertising} = g_1 + g_2(Q4^{*}\text{Quarters Elapsed}) + g_3(\text{Recession}^{*}\text{Quarters Elapsed}) + g_4(\text{Predicted Values for E-commerce Share})
\]  

(6)

Just as with internet advertising expenditure in dollars, the inclusion of an additional variable captured the effect of irrational exuberance on internet advertising share:

\[
\text{Internet Advertising Share of Total Advertising} = h_1 + h_2(Q4^{*}\text{Quarters Elapsed}) + h_3(\text{Recession}^{*}\text{Quarters Elapsed}) + h_4(\text{Predicted Values for E-commerce Share}) + h_5(\text{Irrational Exuberance})
\]  

(7)

The estimation of Equation (6) was repeated using data only from 2002Q1 onwards, thereby eliminating one of the recessions in the dataset. This allowed for a sensitivity analysis of the results from the main estimation in Equation (6).

In addition, the analysis included similar estimations to Equations (6) and (7) using e-commerce sales, rather than e-commerce share, as an explanatory variable. The estimations took the following form:
Internet Advertising Share of Total Advertising = \( j_1 + j_2(Q4*\text{Quarters Elapsed}) + j_3(\text{Recession}*\text{Quarters Elapsed}) + j_4(\text{Predicted Values for Total E-commerce Sales}) \) 

\[(8)\]

Internet Advertising Share of Total Advertising = \( k_1 + k_2(Q4*\text{Quarters Elapsed}) + k_3(\text{Recession}*\text{Quarters Elapsed}) + k_4(\text{Predicted Values for Total E-commerce Sales}) + k_5(\text{Irrational Exuberance}) \) 

\[(9)\]

Just as with the preceding equations, Equation (8) was also estimated using data only from 2002Q1 onwards.

Finally, though this study did not set out to develop a full model of TV advertising spending, it was interesting to compare the behavior of TV advertising to internet advertising using a similar model. E-commerce sales replaced total retail sales; since TV advertising is more of a brand-building medium and does not have a close tie to e-commerce, total retail sales seemed like a more appropriate sales measurement to use in explaining TV advertising spending. The resulting empirical model can be written as follows:

\[\text{Predicted Total Retail Sales} = m_1 + m_2(\text{Quarters Elapsed}) + m_3(Q4*\text{Quarters Elapsed}) + m_4(\text{Recession}*\text{Quarters Elapsed})\] 

\[(10)\]

The predicted values from this regression were then used to predict TV advertising spending, as follows:

\[TV \text{ Advertising Spending} = n_1 + n_2(Q4*\text{Quarters Elapsed}) + n_3(\text{Recession}*\text{Quarters Elapsed}) + n_4(\text{Predicted Values for Total Retail Sales})\] 

\[(11)\]
5.3 Choice of E-Commerce as Relevant Sales Variable

The nature of internet advertising played a key role in the decision of which sales measurement to use in the empirical analysis of internet advertising. Specifically, if categorizing internet advertising as either persuasive or informative, as discussed in the first portion of the literature review, internet advertising would seem to fit more closely into the category of informative advertising. Informative advertising is in large part dedicated to providing information that would generate sales in the immediate future; for instance, by advertising a sale in the newspaper, a retailer would hope to draw people into its stores within several days. Persuasive advertising, on the other hand, takes a longer-term approach by building a brand image, which then translates into sales over an extended period of time. Though this is by no means a complete picture of both types of advertising, this simplification is useful in thinking about internet advertising.

Over time, internet advertising has provided relatively few brand-building opportunities; rather, advertising has taken the form of classifieds, banners, and increasingly, search, which now constitutes almost 50% of all internet advertising spending. The goal of these advertising formats is to generate click-through, which in the ideal case, leads to conversion into sales. As an illustration, a sponsored search result on Google often gives information on low prices or discounts, in hopes that the consumer will click on the advertisement, and proceed to make a purchase on the company’s website. In a sense, then, most of internet advertising is very similar in nature to classifieds and sales promotions in newspapers and magazines, and less similar to TV advertising, which often strives to create stronger brand association. (This may change over time as digital video gains more traction. For now, however, digital video is still a relatively
small percentage of internet advertising expenditure, so that it is safe to say that most advertising online is informative.)

In fact, when looking at the shares of the major categories of media over time, TV has remained relatively flat over the last couple of years, as has radio, whereas newspapers in particular, but also magazines, have seen a decline. Meanwhile, internet advertising share has grown, which would seem to suggest that some of internet advertising’s share is coming from print media. Given the added benefits of measurability and tracking that the internet provides, this seems logical if it’s true that the function of advertising online and in print is similar. To prove this conclusively more detailed data than is currently available on media expenditures would be needed; however, some general insights can be inferred from the plot of media shares over time (see Fig. 3).

Given the reasoning presented above, the analysis assumed that internet advertising was informative, presenting information and reducing search costs, thereby driving consumers to make purchases in the short-run. The types of purchases made, however, are not in-store purchases. The use of internet advertising to generate in-store sales is still in its early stages. More often than not, the case is that internet advertising generates sales online, on companies’ websites. This is the reason measures like click-through are meaningful; clicks become the equivalent of people stepping foot in a brick-and-mortar store: purchases are not necessarily made, but a visit to the store has taken place. Therefore, due to the close connection between internet advertising and e-commerce sales, e-commerce was chosen as the appropriate sales measure to use to explain advertising spending decisions online. An important distinction to make is that the discussion centers around internet advertising purchased by advertisers, not
necessarily sales generated by internet advertising. Therefore, it is reasonable to assume that internet advertising expenditures are adjusted based on how e-commerce sales are performing.

6. Results and Discussion

6.1 Results

Using the equations presented in the Econometric Model section, this study was able to estimate the effect of e-commerce sales on internet advertising, the impact of the recession on internet advertising apart from the impact on e-commerce, and the effect of a linear time variable on internet advertising after controlling for e-commerce. Then, the estimation turned to the effect of e-commerce share on internet advertising share, as well as the impact of the recession on both variables. The final step involved estimating the effect of total retail sales on TV advertising spending, and examined the impact of the recession on both. The chosen estimation method was two-stage least squares, since it allowed for the simultaneity between sales and advertising.

In the first-stage specifications, since dealing with time-series data, the analysis included performing checks for autocorrelation using the Durbin-Watson test. In the retail sales and e-commerce share specification, the Durbin-Watson statistic was very close to 2, indicating no autocorrelation. In the original estimation of e-commerce sales (see Equation (1)), however, the Durbin-Watson statistic was very low, at approximately 0.3, indicating that there was indeed autocorrelation. In order to control for this, the estimation included a lagged e-commerce sales variable as an independent variable, since there may be factors which cause e-commerce sales to be correlated from one period to another (i.e. changes in consumer confidence). When including both lagged e-commerce sales and a linear time variable in the specification, both appeared significant, but the autocorrelation as measured by the Durbin-Watson alternate test persisted; therefore, the estimation did not include the linear time variable, using only lagged e-commerce
sales to account for the growth in e-commerce. The fit of the model as measured by $R^2$ remained almost the same, at 0.9711 instead of the 0.9748 it had been previously.

Now that the estimation did not include a linear time variable as a dependent variable in the first-stage of the regression, it could include the linear time variable as an independent variable in the second-stage internet advertising estimation (see Equation (2)); the equation was now identified even if the Q4 and recession dummies were also included. The final versions of the estimated regressions are included along with the results tables in Appendix 1. Standard errors are given in parentheses. All estimation was done using the STATA 10.1 statistical software package. All numbers are in thousands unless otherwise specified.

### 6.2 Discussion

Though internet advertising expenditure is the focus of this research, the discussion will first turn to results pertaining to the model for e-commerce sales, the predicted values of which are used to explain internet advertising. It will then interpret the results pertaining to internet advertising spending, and specifically, the impact of the recession on online advertising. Finally, it will examine the issue of linearity in internet advertising expenditure after controlling for e-commerce sales. The final two sections will briefly discuss the results from the estimation of internet advertising share and TV advertising spending.

#### 6.2.1 E-Commerce Sales

According to the estimation method described previously, the empirical results show that for every dollar of e-commerce sales in the previous quarter, there is a 97 cent impact on e-commerce sales in the current quarter. The Q4 dummy interacted with time results in an approximately $186 million increase, so that the holiday season boosts sales by that amount. The
recession dummy, though statistically insignificant, has a negative coefficient, reducing e-commerce sales by approximately $35 million (see Table 1).

One of the most striking aspects of the e-commerce sales estimation is the incredibly close fit of the predicted values when plotted against the actual values, as illustrated in Fig. 4. It is even more interesting when considering that the explanatory variables in this estimation were a lagged e-commerce sales variable, a quarterly dummy scaled by time, and a recession dummy scaled by time. E-commerce has clearly grown at a very linear rate, with predictable boosts provided by 4th quarter retail sales during the holiday season. Interestingly enough, the recession dummy is not significant in the estimation at even the 10% level. However, when examining the graph in Fig. 4, there does appear to be a strong decline in e-commerce from its peak in 2007Q4 to 2009Q1. Even though the 4th quarter peak in 2008 almost coincides with the predicted values, the direction of growth is opposite what it appears based on the model. The model continues to predict an upward trend in e-commerce, while actual values drop quite sharply. There does appear to be an impact of the recession, but it does not appear as being significant in the model. This could most likely be explained by the strong, linear baseline growth of e-commerce, which is captured in the lagged e-commerce variable; there is just not that much left to be explained after linearity is accounted for, which could lead to the statistical insignificance of the recession dummy.

Another interesting result pertaining to e-commerce sales is the lack of strong decline in e-commerce during the 2001 recession. This is especially surprising given that the recession brought the collapse of many dot com companies, many of whom specialized in e-commerce of some sort. Internet advertising was affected much more significantly than e-commerce by the 2001 recession, as will be discussed in the following section. The only slight impact of the 2001
recession on e-commerce could be another factor in explaining why the recession dummy is insignificantly significant when included in the e-commerce estimation: of two recessions, only one has a strongly visible impact, thereby understating the significance of the recession dummy. In fact, even the estimation of the e-commerce equation only using data beginning after the 2001 recession resulted in very little change in the coefficients; the fit of the model fell only slightly, from 97% to 95%. A dummy variable for the period of irrational exuberance prior to the 2001 recession dropped out of the estimation, thereby also not contributing in a significant way. The relatively weak effect of the 2001 recession could in part be due to the smaller magnitude of e-commerce sales, though it is unlikely that this is the entire explanation.

Finally, it is interesting to note that e-commerce sales suffered a drop from 2007Q4 to 2008Q4, whereas internet advertising (see Fig. 5 and following section) continued to grow, though less sharply than before. This could be evidence that the connection between e-commerce sales and internet advertising expenditures might be weakening in recent quarters. Due to the relatively limited time span of the data and the incredibly close fit of the existing model, this would be difficult to estimate robustly. It will be interesting to see whether as the recession continues, e-commerce will regain its linear growth, or whether other factors will need to be taken into account to explain its trend over time.

6.2.2 Internet Advertising Expenditure

The results from estimating Equation (2), which is the primary focus of this paper, show that for every dollar increase in e-commerce sales, there is a 16 cent increase in spending on internet advertising (see Table 1). This seems fairly reasonable, since in absolute terms, it is a relatively small fraction of sales. However, when compared to more traditional advertising budgeting methods, which often use rules of thumb to set advertising as a few percentage points
of sales (Lilien, Kotler, and Moorthy 1992), this seems a bit high. The higher proportion of e-commerce sales dedicated to internet advertising could be rationalized by recognizing once again the measurability and tracking capabilities the medium offers. Advertisers can know exactly how much of their e-commerce sales come from internet ads, and since the number is bound to be a significant percentage, the corresponding percentage of e-commerce sales spent on internet advertising would be larger than the percentage of total sales spent on more traditional media; the effects of traditional advertising are less easily quantified and spending on traditional media therefore less easily justified.

Unlike in the estimation results for e-commerce, the recession dummy does have a significant impact on internet advertising expenditure, significant at the 1% level. According to the results, the effect of any particular quarter being a recession quarter actually has a positive effect on internet advertising spending, raising expenditure by almost $20 million. This is a relatively small effect considering that internet advertising expenditure totaled $23.4 billion in 2008. The impact of the Q4 dummy is also relatively minor, reducing internet advertising expenditures by approximately $15 million. The coefficient on the Q4 dummy is negative since internet advertising does not exhibit such strong fourth quarter seasonality as do e-commerce sales. The negative coefficient on the dummy is therefore a downward adjustment to account for the overstatement of Q4 expenditures when e-commerce is used as an explanatory variable.

Just as with the e-commerce estimation, the fit for this model is very high, at 93.3%. The predicted and actual values are plotted in Fig. 5. Two notable factors evident in the graph are the bump in the earlier portion of the graph corresponding to the dot com boom and bust, and the behavior of internet advertising expenditures since the start of the current recession in 2007Q4. As evidenced by the substantial gap between the red and blue lines from approximately 1999Q4
to 2001Q4, the spending on internet advertising during this period was far beyond what was justified based on e-commerce sales; this tends to support the notion of “irrational exuberance,” which was used to describe the excessive investment in new dot com companies whose fundamental value did not perhaps justify the market price, thereby resulting in an asset bubble. The optimism and belief in developing online technologies and businesses could very well have been reflected in spending on internet advertising, which was also a relatively new and quickly developing medium. When an “irrational exuberance” dummy was included in the estimation, however, it dropped out, leaving the coefficients and the fit unchanged (see Table 2). Moreover, when only data after the 2001 recession was used (see Fig. 6), the coefficients did not exhibit much change: the Q4 downward adjustment was slightly larger, going from $15 million to $16 million. The recession dummy had a slightly higher positive effect, going from a little less than $20 million to $21 million. The fit of the model, however, was higher at 97.5%, up from 93.3% (see Table 3).

The second notable aspect of internet advertising expenditure is the increase visible from 2007Q4 to 2008Q4. E-commerce sales suffered a drop during this time period, and even allowing for the positive impact of the recession dummy on internet advertising, the predicted values show internet advertising decreasing, while in reality, there was an increase, though much smaller than in previous quarters. As mentioned in the previous section, this could be evidence of another factor at play, though more data and time is needed to ascertain what this other factor may be.

The results described in this section, however, answer most of the questions posed regarding the first portion of this research. First, it appears that e-commerce sales do provide a good baseline model to control for the rapid growth in internet advertising, so that the growth is
highly correlated with the growth in sales in the field most affected by internet advertising: e-commerce. Second, even after controlling for the recession in e-commerce, there is a statistically significant impact of the recession on internet advertising. Finally, the recession variable seems to have a positive effect on internet advertising expenditure as expected given the distinct benefits provided by the medium that are increasingly valuable when budgets are constrained and every dollar needs to be accounted for. The following section seeks to answer the remaining questions posed relating to the impact of a linear time variable on internet advertising.

### 6.2.3 Linearity

A question remaining to be answered in the analysis pertains to the persistence of linearity in internet advertising after controlling for the impact of a linear time variable on e-commerce sales. This is particularly important, since this will determine whether the high correlation between internet advertising and e-commerce is due to both variables’ linearity, or whether there is actually causality present, as would be expected given the research on the advertising-sales relationship. The results appear reassuring: after controlling for the effect of the linear growth in e-commerce using lagged e-commerce sales, and then using the fitted values to predict internet advertising expenditure, the linear time variable (indicated as ecommercequarters in Tables 1 and 2, and as quarterswobubble in Table 3) drops out of the equation. It appears, therefore, that the linearity in internet advertising is driven by the linearity in e-commerce, which in turn, affects internet advertising.

### 6.2.4 Internet Advertising Share

The results from estimating the impact of e-commerce share and the recession on internet advertising share (see Table 4) are similar to those of e-commerce sales on internet advertising
sales. In the first-stage of the estimation, a linear time variable serves to control for the rapid growth in e-commerce share and is significant at the 1% level. Also, Q4 provides a significant boost to e-commerce share, which is also significant at the 1% level. The recession dummy has a negative effect, though as with e-commerce sales, the effect is not statistically significant.

Once again, the incredibly good fit of the model is surprising. In fact, the fit for e-commerce share is even higher, at 98.4%, than it was for e-commerce sales. Explaining why e-commerce sales and share have grown so linearly might be an interesting topic for future research. Also interesting is the behavior of e-commerce from 2007Q4 to 2008Q4: unlike e-commerce sales, e-commerce share continued to increase during this time, so that the direction of growth in the predicted model coincides with the direction of growth in actual values (see Fig.7). The growth has persisted despite the current recession and the negative coefficient on the recession dummy. The graph of e-commerce share also shows no sharp decline during the 2001 recession, much like the graph of e-commerce sales.

Turning now to the second-stage estimation (see Table 4 and Fig. 8), e-commerce share has a strong effect on internet advertising share, significant at the 1% level: for every 1% increase in e-commerce share, there is an approximately 3% increase in internet advertising share. The recession dummy is also significant at the 1% level, and is positive, just as in the estimation of internet advertising spending. As in the first case, the impact of the recession dummy, though positive, is relatively small. Also as before, the Q4 dummy has a negative coefficient, acting as a downward adjustment to the sharp seasonality of e-commerce share. Though the fit, at 88.8%, is not quite as good as in the first model, the main results from the first estimation still hold even when dealing with shares, rather than absolute dollar amounts.
Unlike the initial estimation in dollars, however, the estimation in shares does exhibit changes once an “irrational exuberance” dummy is introduced (see Table 5). Though the dummy is not significant in the first-stage estimation, its inclusion slightly increases the impact of the recession dummy, though it still remains minor. In the second-stage estimation, the “irrational exuberance” dummy is statistically significant at the 1% level, boosting internet advertising share by 3%, an impact almost equal in magnitude to the effect of e-commerce share, which grows to almost 4%. The recession coefficient increases slightly, as does the downward Q4 adjustment. The constant term exhibits a strong decline, from around 2.6 to 0.5. Finally, the fit of the model grows from 88.8% to 93.9%. Fig. 9 plots the new fitted values against internet advertising share. From 1999Q4 to 2000Q4, the fit is almost perfect. Since internet advertising share only started declining towards the end of the 2001 recession, however, there is still a gap in values during the recession.

Once the data is truncated, starting at 2002Q1 after the 2001 recession (see Table 6), the fit of the model grows even higher to 97.7%. The impact of e-commerce increases, so that a 1% increase in e-commerce boosts internet advertising share by 5%, up from around 3% in the original estimation. In the first-stage estimation, there is not much change: only the recession dummy exhibits a slightly stronger negative effect. In the second-stage, however, the recession now has a slightly weaker impact, which makes sense given that there is now only one recession in the dataset. The downward Q4 adjustment increases slightly. A plot of the new fitted values (see Fig.10) shows that unlike the estimation of internet advertising spending in dollar terms, the fit of the internet advertising share estimation does grow much closer once the dot com boom and bust periods are excluded from the data.
The above discussion related to the estimation of internet advertising share using e-commerce share as an explanatory variable. When using ecommerce sales, rather than share, as an explanatory variable, the results (see Table 7) are similar to the results from the previous estimations: e-commerce sales has a statistically significant impact on internet advertising share, though for every dollar increase in e-commerce, the increase in internet advertising share is miniscule. The Q4 dummy once again serves as a slight downward adjustment, while the recession dummy exhibits a weak, though significant, positive effect. The linear time variable and the constant term drop out of the estimation. The fit, however, is much lower than for the other two estimations, at 79.7%. The plot of fitted against actual values using this model specification is very similar to the graph generated in the initial estimation (Fig.4): there is a large gap between the values during the dot com boom and bust period, and internet advertising share continues to rise during the current recession, contrary to the predicted trend. Just as with the initial estimation, neither the inclusion of an “irrational exuberance” dummy, nor truncation of the data, have an impact on the estimated coefficients (see Tables 8 and 9). In the case of the truncated data, however, the fit rises dramatically, from 79.7% to 96.6%.

Despite some differences in reacting to the inclusion of a dummy to control for the period of “irrational exuberance”, all of the estimations conducted show a statistically significant, positive impact of the recession on internet advertising expenditure, both in dollar and share terms.

### 6.2.5 TV Advertising Expenditure

The results from estimating total retail sales show many similarities to the e-commerce sales estimation (see Table 10). For instance, much of the growth in retail sales can be modeled using a linear time variable, which is significant at the 1% level. Q4 provides a sales boost,
which is also significant at the 1% level. Also, just as with e-commerce, the recession dummy
has a negative coefficient, though in this estimation, it is significant at the 5% level. Finally, total
retail sales suffered a drop from 2007Q4 to 2008Q4, much like e-commerce (see Fig. 12). The
total fit of the model is much lower, at 81.8%, than it was for e-commerce, suggesting that retail
sales are much less linear than e-commerce sales.

In the second-stage of the estimation, TV advertising expenditure is regressed on the
predicted values of total retail sales, a Q4 dummy interacted with a time variable, and a recession
dummy interacted with a time variable. The results show that none of the variables aside from
the predicted retail sales variable were statistically significant (see Table 3); in fact, both dummy
variables drop out of the estimation. The retail sales variable, however, is significant at the 1%
level. The fit for the model is much lower than it was for internet advertising expenditure, having
an R\(^2\) of only 74.8% compared to the 93% for internet advertising. The purpose of this model,
however, was not to develop a perfectly fitting model for TV advertising; rather, it was to see
how the same model used for estimating internet advertising spending would fare with TV
advertising. Specifically, it was interesting to see whether the media would exhibit different
behaviors, especially during the recessionary period, as predicted in the Economic Model
section. The results show that there is no significant impact of the recession on TV advertising
apart from the impact on retail sales, as there was with internet advertising. Moreover, due to the
negative impact of the recession on retail sales, which then impact TV advertising, TV
advertising will tend to decrease during recessionary periods. Finally, unlike internet advertising
expenditure, TV advertising expenditure suffered a drop from 2007Q4, the start of the current
recession, to 2008Q4, following the pattern in sales (see Fig.13). Together with the estimation
results, this tends to suggest that, as predicted, TV advertising does fare worse during a recession that internet advertising.

7. Conclusions and Directions for Future Research

This research shows that e-commerce is a good starting point for beginning to explain the growth in internet advertising. Recessions seem to impact internet advertising expenditures positively apart from their effect on e-commerce, though the magnitude is relatively small. Moreover, the linearity that characterizes internet advertising and confounds estimation results can be removed by controlling for the linear growth in the estimation of e-commerce, and then using the predicted values of e-commerce as an explanatory variable in estimating internet advertising spending. These results hold whether measuring internet advertising in absolute dollar terms or as a share of total advertising. Recessions also have a negative impact on both e-commerce and retail sales, though the effect is not always statistically significant. Q4, on the other hand, provides a statistically significant boost to both online and total retail sales. Finally, TV advertising exhibits differing behavior from internet advertising, suggesting that the benefits afforded by internet advertising make it a more attractive medium during bad economic conditions.

A limitation of this study is that, as stated previously, there is still no conclusive evidence regarding the causality between advertising and sales, so that despite the two-stage least squares method employed, there may still be some endogeneity concerns. Another limitation is that with only two recessions during this time period covered by the dataset, one of which occurred when internet advertising was still a fairly new medium, these results may not be as conclusive as would be wished. Despite the limited nature of the data (and short of hoping for more recessions in the future), the positive effect of recessions on internet advertising in this dataset is yet another
piece of the puzzle that supports analytically the suppositions regarding the advantages of internet advertising.

There is still much to be learned, however, about both internet advertising and e-commerce. With more data available as time progresses, future research could address the factors driving the linearity in e-commerce; internet adoption seems to be promising, though issues with measurement and endogeneity will first have to be resolved. Moreover, this study has focused on internet advertising and e-commerce at an aggregate level; future research could examine whether these results hold at the industry level, as well as investigate cross-industry differences in online advertising behavior. Finally, with the recent decline in internet advertising over the last two quarters, it is questionable whether it will resume its linear growth once the economy recovers. If not, the strongly linear baseline might not overshadow as much of the short-term fluctuation, making it possible to examine short-run online advertising expenditure decisions, whether at an aggregate or industry level. Formal models of internet advertising expenditure decisions could then be constructed, with factors such as risk expectations entering into the formulation; for instance, when bad economic conditions are anticipated, internet advertising would be expected to increase due to the advantages described previously. These are just some possibilities for further study of the developing and dynamic field of internet advertising.

While Picard (2001) complains that there is not enough research done on the impact of the economy on advertising, there is at least a whole realm of study focusing on modeling advertising decisions. The literature on internet advertising specifically is still fairly scant, so that further analysis is needed to get a better grasp on the medium that has revolutionized the advertising world.
Appendix 1: Tables and Figures

Fig. 1

Internet Advertising Expenditure Over Time

[Graph showing the trend of internet advertising expenditure over time, with data points plotted from 1997 to 2009.]
Fig. 2

Nominal GDP Over Time

Dollars (in millions)

Quarter

Nominal GDP (Seasonally Adjusted At Annual Rates)
Source: Ad$ spender by TNS Media Intelligence
Methodology detailed in Appendix 4
Fig. 4

Actual vs. Fitted Internet Advertising Expenditure

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Fig. 5

Actual vs. Fitted E-Commerce Sales
Fig. 6

Actual vs. Fitted Internet Advertising Expenditure (Using Data Starting from 2002Q1)
Fig. 7

Actual vs. Fitted E-Commerce Share of Total Retail Sales
Fig. 8

Actual vs. Fitted Share of Internet Advertising as Percentage of Total Advertising

- Actual Share of Internet Advertising
- Predicted Share of Internet Advertising
Fig. 9

Actual vs. Fitted Share of Internet Advertising as a Share of Total Advertising (Controlling for “Irrational Exuberance”)
Fig. 10

Actual vs. Fitted Share of Internet Advertising as Percentage of Total Advertising (Using Data Beginning from 2002Q1)
Actual vs. Fitted Share of Internet Advertising as Percentage of Total Advertising (Using E-Commerce Sales as Explanatory Variable)
Actual vs. Fitted Retail Sales

Dollars (in billions)

Quarter

Fitted Retail Sales
Actual Retail Sales
Actual vs. Fitted TV Advertising Expenditure

Fitted TV Advertising Expenditure

Actual TV Advertising Expenditure
Table 1

Predicted Total E-Commerce Sales = a_1 + a_2(Lagged E-Commerce Sales) + a_3(Q4*Quarters Elapsed) + a_4(Recession*Quarters Elapsed)

(1)

Internet Advertising Spending = b_1 + b_2(Q4*Quarters Elapsed) + b_3(Recession*Quarters Elapsed) + b_4(Predicted Values for Total E-commerce Sales) + b_5(Quarters Elapsed)

(2)

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Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Table 2

**Predicted Total E-Commerce Sales**

\[ \text{Predicted Total E-Commerce Sales} = c_1 + c_2(\text{Lagged E-Commerce Sales}) + c_3(Q4*\text{Quarters Elapsed}) + c_4(\text{Recession*Quarters Elapsed}) + c_5(\text{Irrational Exuberance}) \]

(3)

**Internet Advertising Spending**

\[ \text{Internet Advertising Spending} = d_1 + d_2(Q4*\text{Quarters Elapsed}) + d_3(\text{Recession*Quarters Elapsed}) + d_4(\text{Predicted Values for Total E-commerce Sales}) + d_5(\text{Irrational Exuberance}) + d_6(\text{Quarters Elapsed}) \]

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Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Using data only from 2002Q1 onwards:

\[
\text{Predicted Total E-Commerce Sales} = e_1 + e_2(\text{Lagged E-Commerce Sales}) + \\
e_3(\text{Q4*Quarters Elapsed}) + e_4(\text{Recession*Quarters Elapsed})
\]

\hspace{1cm} (5)

\[
\text{Internet Advertising Spending} = g_1 + g_2(\text{Q4*Quarters Elapsed}) + g_3(\text{Recession*Quarters Elapsed}) + g_4(\text{Predicted Values for Total E-commerce Sales}) + g_5(\text{Quarters Elapsed})
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Standard errors in parentheses
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Table 4

Predicted E-Commerce Share of Total Retail Sales = \( h_1 + h_2(\text{Quarters Elapsed}) + h_3(\text{Q4*Quarters Elapsed}) + h_4(\text{Recession*Quarters Elapsed}) \)

(7)

Internet Advertising Share of Total Advertising = \( j_1 + j_2(\text{Q4*Quarters Elapsed}) + j_3(\text{Recession*Quarters Elapsed}) + j_4(\text{Predicted Values for E-commerce Share}) \)

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Standard errors in parentheses
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Table 5

Predicted E-Commerce Share of Total Retail Sales = $k_1 + k_2(\text{Quarters Elapsed}) + k_3(\text{Q4*Quarters Elapsed}) + k_4(\text{Recession*Quarters Elapsed}) + k_5(\text{Irrational Exuberance})$

\begin{equation}
\text{Internet Advertising Share of Total Advertising} = m_1 + m_2(\text{Q4*Quarters Elapsed}) + m_3(\text{Recession*Quarters Elapsed}) + m_4(\text{Predicted Values for E-commerce Share}) + m_5(\text{Irrational Exuberance})
\end{equation}

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<td>Q4interactiondummy</td>
<td>0.00880***</td>
<td>-0.0652***</td>
</tr>
<tr>
<td></td>
<td>(0.00136)</td>
<td>(0.0110)</td>
</tr>
<tr>
<td>irrationalexuberance</td>
<td>0.1005</td>
<td>3.153***</td>
</tr>
<tr>
<td></td>
<td>(0.0725)</td>
<td>(0.550)</td>
</tr>
<tr>
<td>recessioninteraction</td>
<td>-0.000891</td>
<td>0.0771***</td>
</tr>
<tr>
<td></td>
<td>(0.00184)</td>
<td>(0.0142)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.473***</td>
<td>0.454</td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
<td>(0.552)</td>
</tr>
<tr>
<td>Observations</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.985</td>
<td>0.939</td>
</tr>
</tbody>
</table>

|                         |                      |
| Standard errors in parentheses |
| *** p<0.01, ** p<0.05, * p<0.1 |
Table 6

Using data only from 2002Q1 onwards:

\[
\text{Predicted E-Commerce Share of Total Retail Sales} = n_1 + n_2(\text{Quarters Elapsed}) + n_3(\text{Q4*Quarters Elapsed}) + n_4(\text{Recession*Quarters Elapsed})
\]

\( (11) \)

\[
\text{Internet Advertising Share of Total Advertising} = p_1 + p_2(\text{Q4*Quarters Elapsed}) + p_3(\text{Recession*Quarters Elapsed}) + p_4(\text{Predicted Values for E-commerce Share})
\]

\( (12) \)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(11) ecommerceshare</th>
<th>(12) netshare</th>
</tr>
</thead>
<tbody>
<tr>
<td>quarterswobubble</td>
<td>0.0791***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0015)</td>
<td></td>
</tr>
<tr>
<td>Q4interactiondummy</td>
<td>0.00905***</td>
<td>-0.0733***</td>
</tr>
<tr>
<td></td>
<td>(0.0015)</td>
<td>(0.00757)</td>
</tr>
<tr>
<td>recessioninteraction</td>
<td>-0.000833</td>
<td>0.0345***</td>
</tr>
<tr>
<td></td>
<td>(0.0023)</td>
<td>(0.0107)</td>
</tr>
<tr>
<td>ecommerceshare</td>
<td></td>
<td>5.251***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.241)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.185***</td>
<td>-2.632***</td>
</tr>
<tr>
<td></td>
<td>(0.0566)</td>
<td>(0.529)</td>
</tr>
<tr>
<td>Observations</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.972</td>
<td>0.977</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 7

Predicted Total E-Commerce Sales = $q_1 + q_2$(Lagged E-Commerce Sales) + $q_3$(Q4*Quarters Elapsed) + $q_4$(Recession*Quarters Elapsed)

(13)

Internet Advertising Share of Total Advertising = $r_1 + r_2$(Q4*Quarters Elapsed) + $r_3$(Recession*Quarters Elapsed) + $r_4$(Predicted Values for Total E-commerce Sales) + $r_5$(Quarters Elapsed)

(14)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(13)</th>
<th>(14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalecommercesales</td>
<td>$4.61e-07^{***}$</td>
<td>$-0.0829^{***}$</td>
</tr>
<tr>
<td>Q4interactiondummy</td>
<td>$185.916^{***}$</td>
<td>$-0.0829^{***}$</td>
</tr>
<tr>
<td>recessioninteraction</td>
<td>$-34,875$</td>
<td>$0.0482^{**}$</td>
</tr>
<tr>
<td>ecommercequarters</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>L.totalecommercesales</td>
<td>0.968^{***}</td>
<td>0.0197</td>
</tr>
<tr>
<td>Constant</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Observations</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.970</td>
<td>0.797</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 8

Predicted Total E-Commerce Sales = $s_1 + s_2(\text{Lagged E-Commerce Sales}) +$

$s_3(Q4*\text{Quarters Elapsed}) + s_4(\text{Recession}*\text{Quarters Elapsed}) + s_5(\text{Irrational Exuberance})$

(15)

Internet Advertising Share of Total Advertising = $t_1 + t_2(Q4*\text{Quarters Elapsed}) +$

$t_3(\text{Recession}*\text{Quarters Elapsed}) + t_4(\text{Predicted Values for Total E-commerce Sales}) + t_5(\text{Irrational Exuberance}) + t_6(\text{Quarters Elapsed})$

(16)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(15) totalecommercesales</th>
<th>(16) netshare</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalecommercesales</td>
<td>4.62e-07***</td>
<td></td>
</tr>
<tr>
<td>irrationalexuberance</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>ecommercequarters</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>Q4interactiondummy</td>
<td>185,916***</td>
<td>-0.0832***</td>
</tr>
<tr>
<td></td>
<td>(20,309)</td>
<td>(0.0202)</td>
</tr>
<tr>
<td>recessioninteraction</td>
<td>-34,876</td>
<td>0.0473**</td>
</tr>
<tr>
<td></td>
<td>(25,505)</td>
<td>(0.0234)</td>
</tr>
<tr>
<td>L.totalecommercesales</td>
<td>0.968***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>Observations</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.970</td>
<td>0.797</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Using data only from 2002Q1 onwards:

**Predicted Total E-Commerce Sales**

\[
\text{Predicted Total E-Commerce Sales} = u_1 + u_2(\text{Lagged E-Commerce Sales}) + u_3(\text{Q4*Quarters Elapsed}) + u_4(\text{Recession*Quarters Elapsed})
\]

(17)

**Internet Advertising Share of Total Advertising**

\[
\text{Internet Advertising Share of Total Advertising} = v_1 + v_2(\text{Q4*Quarters Elapsed}) + v_3(\text{Recession*Quarters Elapsed}) + v_4(\text{Predicted Values for Total E-commerce Sales}) + v_5(\text{Quarters Elapsed})
\]

(18)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(17) totalcommercesales</th>
<th>(18) netshare</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalcommercesales</td>
<td>4.52e-07***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(8.33e-09)</td>
<td></td>
</tr>
<tr>
<td>Q4interactiondummy</td>
<td>187,109***</td>
<td>-0.0872***</td>
</tr>
<tr>
<td></td>
<td>(23,452)</td>
<td>(0.00894)</td>
</tr>
<tr>
<td>recessioninteraction</td>
<td>-32,773</td>
<td>0.0496***</td>
</tr>
<tr>
<td></td>
<td>(28,402)</td>
<td>(0.00994)</td>
</tr>
<tr>
<td>quarterswobubble</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>L.totalcommercesales</td>
<td>0.966***</td>
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<tr>
<td></td>
<td>(0.0230)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
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<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
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<tr>
<td>Observations</td>
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<td>30</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.950</td>
<td>0.966</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 10

Predicted Total Retail Sales = \( w_1 + w_2(Quarters Elapsed) + w_3(Q4*Quarters Elapsed) + w_4(Recession*Quarters Elapsed) \)

(19)

TV Advertising Spending = \( x_1 + x_2(Q4*Quarters Elapsed) + x_3(Recession*Quarters Elapsed) + x_4(Predicted Values for Total Retail Sales) \)

(20)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(19) totalretailsales</th>
<th>(20) TVdols</th>
</tr>
</thead>
<tbody>
<tr>
<td>ecommercequarters</td>
<td>8.718e+06***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(828,221)</td>
<td></td>
</tr>
<tr>
<td>recessioninteraction</td>
<td>-1.814e+06**</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(681,734)</td>
<td>(0)</td>
</tr>
<tr>
<td>Q4interactiondummy</td>
<td>1.743e+06***</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(519,746)</td>
<td>(0)</td>
</tr>
<tr>
<td>totalretailsales</td>
<td>0.0175***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000173)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>6.966e+08***</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(1.600e+07)</td>
<td>(0)</td>
</tr>
<tr>
<td>Observations</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.818</td>
<td>0.748</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Appendix 2: Definitions of Variables Used in STATA Output

000 indicates that variable is in thousands.

internetadvertisingrevenue000: Internet advertising expenditure. Source: IAB.

quarter: linear time variable: quarters elapsed since 1997Q1

totalecommercesales: Total e-commerce sales. Source: Census E-stats. In thousands.
http://www.census.gov/retail/

L.totalecommercesales: totalecommercesales lagged by one period.


Q4interactiondummy: Q4ecommerce*ecommercequarters. Intended to scale 4th quarter effect.

recession: Linear recession dummy. =1 if recession. =0 otherwise. Begins in 1999Q4.

recessioninteraction: recession*ecommercequarters.

totalsales: Total retail sales. Source: Census E-stats. In thousands.
http://www.census.gov/retail/

ecommerceshare: (totalecommercesales/totalsales)*100

updatedtotaldols: total advertising spending (Source: Ad$pend by TNS Media Intelligence) with Ad$pend’s internet spending data removed and replaced with internetadvertisingrevenue000, since the latter includes search and contains data for earlier periods than had been collected by Ad$pend.

netshare: (internetadvertisingrevenue000/updatedtotaldols)*100

TVdols: TV advertising expenditure. Source: Ad$pend. Sum of expenditures on Network TV, Spanish Language Network TV, Cable TV, Syndication, and Spot TV. Link to full methodology available in Appendix 4.

irrationalexuberance: dummy variable taking the values 1 from 1999Q4 to 2000Q4.

Appendix 3: Definitions of Types of Internet Advertisements

<table>
<thead>
<tr>
<th>Advertising Formats</th>
<th>Definitions of Advertising Formats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Advertising (Banner Ads)</td>
<td>Advertiser pays an Internet company for space to display a static or hyper-linked banner or logo on one or more of the Internet company’s pages.</td>
</tr>
</tbody>
</table>
| Sponsorship                          | Represents custom content and/or experiences created for an advertiser which may or may not include ad elements such as display advertising, brand logos, advertorial or pre-roll video. Sponsorships fall into several categories:  
  • Spotlights are custom built pages incorporating an advertiser’s brand and housing a collection of content usually around a theme  
  • Advergaming can range from an advertiser buying all the ad units around a game or a “sponsored by” link to creating a custom branded game experience  
  • Content & Section Sponsorship is when an advertiser exclusively sponsors a particular section of the site or email (usually existing content) re-skinned with the advertiser’s branding  
  • Sweepstakes & Contests can range from branded sweepstakes on the site to a full-fledge branded contest with submissions and judging |
| E-mail                               | Banner ads, links or advertiser sponsorships that appear in e-mail newsletters, e-mail marketing campaigns and other commercial e-mail communications. Includes all types of electronic mail (e.g., basic text or HTML-enabled).                                                                                                                                                                |
| Search                               | Fees advertisers pay Internet companies to list and/or link their company site domain name to a specific search word or phrase (includes paid search revenues). Search categories include:  
  • Paid listings—text links appear at the top or side of search results for specific keywords. The more a marketer pays, the higher the position it gets. Marketers only pay when a user clicks on the text link.  
  • Contextual search—text links appear in an article based on the context of the content, instead of a user-submitted keyword. Payment only occurs when the link is clicked.  
  • Paid inclusion—guarantees that a marketer’s URL is indexed by a search engine.  
  |

Lara Stiris Gluck  
12/9/2009  
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<table>
<thead>
<tr>
<th>Engine</th>
<th>The listing is determined by the engine's search algorithms.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• <strong>Site optimization</strong>—modifies a site to make it easier for search engines to automatically index the site and hopefully result in better placement in results.</td>
</tr>
</tbody>
</table>

| Lead Generation  | Fees advertisers pay to Internet advertising companies that refer qualified purchase inquiries (e.g., auto dealers which pay a fee in exchange for receiving a qualified purchase inquiry online) or provide consumer information (demographic, contact, behavioral) where the consumer opts into being contacted by a marketer (email, postal, telephone, fax). These processes are priced on a performance basis (e.g., cost-per-action, -lead or -inquiry), and can include user applications (e.g., for a credit card), surveys, contests (e.g., sweepstakes) or registrations. |

| Classifieds and auctions | Fees advertisers pay Internet companies to list specific products or services (e.g., online job boards and employment listings, real estate listings, automotive listings, auction-based listings, yellow pages). |

| Rich media          | Advertisements that incorporate animation, sound, and/or interactivity in any format. It can be used either singularly or in combination with the following technologies: sound, Flash, and with programming languages such as Java, JavaScript, and DHTML. It is deployed via standard Web and wireless applications including e-mail, static (e.g., .html) and dynamic (e.g., .asp) Web pages, and may appear in ad formats such as banners, buttons and interstitials. Interstitials are included in the rich media category and represent full- or partial-page text and image server-push advertisements which appear in the transition between two pages of content. Forms of interstitials can include splash screens, page takeovers and pop-up windows. |

| Digital Video Commercials | TV-like advertisements that may appear as in-page video commercials or before, during, and/or after a variety of content in a player environment including but not limited to, streaming video, animation, gaming, and music video content. This definition includes digital video commercials that appear in live, archived and downloadable streaming content. |

(IAB 2009, p. 16)
Appendix 4: Methodology for Data on Media Expenditures Presented in Fig. 3

Below is a list of all the media for which Ad$spender reports expenditure data. Fig. 3 was generated by grouping all TV subcategories into one, with the same being done for magazines, newspapers, and radio. All subcategories consist of distinct datasets, and can therefore be added to calculate aggregate expenditure for a medium, such as TV. The table below also reports the dates for which data was collected for each medium. Fig. 3 begins in 2003Q1, since this is the latest date that a new subcategory was introduced; therefore, the graph begins when all currently tracked media expenditures were reported, thereby making the share plots comparable over time.

A more complete methodology description, detailing how data for each medium was collected, can be found at the following URL:

<table>
<thead>
<tr>
<th>Medium</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network TV</td>
<td>1/1/1995 - 7/31/2009</td>
</tr>
<tr>
<td>Span Lang Net TV</td>
<td>1/1/1997 - 7/31/2009</td>
</tr>
<tr>
<td>Cable TV</td>
<td>1/1/1995 - 7/31/2009</td>
</tr>
<tr>
<td>Syndication</td>
<td>1/1/1995 - 7/31/2009</td>
</tr>
<tr>
<td>Spot TV</td>
<td>1/1/1995 - 7/31/2009</td>
</tr>
<tr>
<td>Local Magazines</td>
<td>1/1/2002 - 8/31/2009</td>
</tr>
<tr>
<td>Hispanic Magazines</td>
<td>1/1/2003 - 8/31/2009</td>
</tr>
<tr>
<td>Natl Newspapers</td>
<td>1/1/1995 - 7/31/2009</td>
</tr>
<tr>
<td>Newspapers</td>
<td>1/1/1999 - 7/31/2009</td>
</tr>
<tr>
<td>Hispanic Newspapers</td>
<td>1/1/1999 - 7/31/2009</td>
</tr>
<tr>
<td>US Internet</td>
<td>1/1/2001 - 7/31/2009</td>
</tr>
<tr>
<td>Outdoor</td>
<td>1/1/1995 - 6/30/2009</td>
</tr>
</tbody>
</table>
Reference List


