The Relevance of Web Traffic for Internet Stock Prices

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Abstract

We find that web traffic is relevant for explaining market values and stock returns of pure Internet companies after controlling for accounting information such as book values and earnings. However, we find weak associations between web traffic and sales levels and sales growth. We conjecture that traffic creates future growth potential through network effects and customer relationships that do not necessarily result in current realized sales revenues. We provide preliminary evidence in support of this conjecture by documenting strong associations between acquisition prices and website traffic for a sample of Internet acquisitions.

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1. Introduction

It has been argued that financial information of firms in the Internet sector is of limited value to investors. Some contend that traditional metrics (such as price to earnings ratio) work best with traditional businesses, not with the emerging technology intensive Internet businesses (Barron's, November 15, 1999). Indeed, companies such as Amazon.com are often valued in multiples of their revenues due to the absence of positive earnings. The mean Internet firm in our sample has a market to book ratio of 17.92 despite the fact that 79% of the firms reported *negative* earnings. Such apparently anomalous relations between market values and key financial measures raise questions about the role of non-financial information in explaining market values of Internet companies. In this paper, we explore the role of website traffic as one potentially important value driver for Internet firms. We examine the implications of web traffic for firm values, sales levels and sales growth for a sample of pure Internet firms.

Web traffic (often referred to as "eyeballs") is hypothesized to be an important economic indicator for firm value because without traffic and a critical mass of visitors it is impossible to build customer relationships that can be converted to future sales revenues. Perhaps, that partially explains why traffic is a key non-financial measure actively followed by the investment community to value Internet firms (Houston Chronicle, November 22, 1999). Moreover, traffic is a simple, easily understandable measure that is often obtainable from company press releases or from other third-party survey firms such as PC Data and Media Metrix. Further, traffic is a measure that applies relatively well across several web business models, including e-commerce and content

sites.

Using survey data obtained from PC Data, we examine whether the economic value of traffic (proxied by percentage of Internet users that a firm attracts) is reflected in the market value of equity after controlling for contemporaneous financial statement information such as book value of equity and earnings. Our results indicate that traffic is positively associated with stock prices and adds significant incremental explanatory power (13%) to a regression of just financial statement information against Internet share prices.

To better appreciate the value-relevance of traffic, we view traffic as a managerial choice variable and model the factors and constraints affecting website traffic. We posit that developing an alliance with America Online, setting up affiliate programs, developing media visibility and marketing expenditures contribute to firm traffic whereas cash availability and industry membership constrain managers from increasing traffic. We find that media visibility and cash availability are key drivers of traffic.

Conditional on traffic being a managerial choice variable, our findings suggest that the value-relevance of traffic stems from the factors that drive traffic. Our approach of treating traffic as a choice variable differs from previous studies of the value relevance of non-financial measures (e.g., customer satisfaction in Ittner and Larcker, 1998; population coverage in Amir and Lev, 1996). These studies view non-financial measures as exogenous variables and are hence silent about why value-maximizing managers would not increase the non-financial measure infinitely in an attempt to increase firm value (Lambert, 1998; Nagar, 2000). In contrast, this study suggests that constraints such as cash balances possibly prevent managers from increasing traffic to infinite levels.

Although traffic is highly value relevant, we find weak and insignificant associations between traffic and operational measures such as sales levels or sales growth. We conjecture that the value relevance of traffic stems from potential intangible assets created from network effects and customer relationships that could produce future sales revenues. Network effects occur when acquiring traffic in the early stages can create a critical mass of users, or customers, making future acquisition of customers less expensive in networked industries such as the Internet (Arthur, 1996; Shapiro and Varian, 1999). Current traffic can also help firms build customer relationships and gather data about buying and surfing behavior of these visitors. Such relationships and data could result in future revenues. Anecdotal evidence also suggests that acquiring web traffic could create economic value. As a case in point, in October 1999, Excite@home, an Internet portal, agreed to acquire Bluemountainarts.com, an electronic greetings card website, for $780 million in cash and stock. Although Bluemountainarts.com had virtually no revenues and profits, it was the third ranked e-commerce site in terms of web traffic, behind AOL and Amazon.com with over 9.2 million monthly visitors (Wall Street Journal, October 18, 1999).

To provide further evidence on the conjecture that traffic is value-relevant for its future growth potential, we examine whether acquisition prices paid for 42 acquisitions of Internet companies during the year ended September 30, 1999 are associated with traffic figures of the target firms. We find that acquiring firms, on average, pay $167 for each monthly visitor to the target firms' website. Further, target firms' traffic numbers account for 77% of the cross sectional variation in acquisition prices suggesting that the market for corporate control values future growth from acquiring web traffic.

Concurrent work by Trueman, Wong, and Zhang (1999) also examines whether measures of web traffic (unique visitors and page views) drawn from a different rating agency (Media Metrix) explain cross-sectional variation in shareholder value after controlling for financial measures.[1] Our paper differs from Trueman, et al. (1999) in two important respects. First, we view traffic as an endogenous choice variable which optimizing managers select based on costs and constraints. Thus, we identify institutional factors that contribute to and constrain traffic. Second, we show that the value-relevance for traffic does not stem from fundamental links between traffic and revenues but possibly from future growth potential.

The remainder of the paper is organized as follows. Section 2 discusses the importance of traffic for Internet firms. Section 3 describes the data and Section 4 explores the value relevance of web traffic. Section 5 examines the relation between traffic and firm revenues. Section 6 assesses the association between acquisition prices and traffic numbers of acquired websites. Section 7 concludes.

2. The importance of traffic

Industry experts predict that the Internet will become so pervasive that in the near future that every business will be an Internet business (Grove, 1996; Economist, 1999; Hamel and Sampler, 1998). Online retail sales are forecasted to reach $184 billion by 2004 as compared to $700 million in 1996 (Modahl, 2000). To capitalize on this huge opportunity, a record number of companies trying to sell goods and services online went public in 1999 (Business 2.0, 2000). Given that the Internet is characterized by lower

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[1] In a related paper, Hand (2000) investigates the pricing of Internet firms using disaggregated financial information.

barriers to entry, attracting traffic may be necessary for an online firm's ability to survive. For example, ValueAmerica, an Internet superstore, announced a major restructuring of its business primarily because of the firm's inability to attract enough traffic to its website (Wall Street Journal, December 30, 1999).

Attracting traffic to a firm's website is valuable because without traffic and a critical mass of visitors it is impossible to build customer relationships that can be converted to future sales revenues.[2] Tracking visitor behavior on the firm's website can also create important insights into the nature and needs of visitors even though such visitors do not buy goods and services on the website. For example, Amazon.com can use data on failed searches on its website to learn about visitor's preferences and accordingly decide which new product lines to enter. Data on failed searches can also be valuable in deciding the size and composition of inventory that the firm should carry.

Moreover, online businesses operate in environments where the notions of network externalities and positive feedback effects apply (Hagel and Armstrong, 1997; Shapiro and Varian, 1999). When the value of a website to one visitor depends upon how many other users are already active then that website exhibits network externalities, or network effects (Arthur, 1996; Shapiro and Varian, 1999). As the number of visitors grows, more and more users find that website attractive because of their ability to interact with other users and the ability to share and contribute to member generated content (e.g., book reviews generated by readers at Amazon.com). The greater member base creates

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[2] A good example of such relationship building is "the Eyes" program offered by Amazon.com. The program is a personal notification service in which customers can register their interests in a particular topic or author on the website. Once customers register they are notified (by e-mail) each time a book by their favorite author, topic, or interest is published (Kotha, 1998). Such notifications are likely to result in future sales for Amazon.com.

opportunities for advertisers and vendors to market a range of products and services to those members. Accumulation of data about member profiles and transaction profiles makes it possible to attract even more vendors and advertisers to tailor the products and services to members,[3] thus making it even more attractive for members to join the virtual community created by the firm (Hagel and Armstrong, 1997). Thus, chasing traffic in the earlier time periods may be value maximizing down the road because the leaders with larger traffic (or user base) can dominate their product space as positive feedback effects take hold (Shapiro and Varian, 1999).[4]

Web traffic is, however, not a uniformly important factor for all online firms. On the one hand, traffic is important for access providers (e.g., AOL and PSINET, companies that assist users get on the Internet), content providers (companies that provide users with news or other specialized content such as Sportsline USA) and portals (e.g., Yahoo and Excite) because such Internet firms can monetize the "eyeballs" they are able to attract to their websites by selling advertisements. E-tailers (e.g., Amazon.com) value traffic because the larger the number of potential customers they can attract to their websites, greater the revenues they can generate from sale of goods and services. On the other hand, traffic is unlikely to be an important value or revenue driver for firms that sell domain names, network or web site security services, or firms that are network infrastructure or software providers.

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[3] For example, tracking book purchases enables Amazon.com to make finer recommendations of other books of interest.

[4] A striking example of network effects is Ebay, the leading auction site. The number of users at Ebay increased 65 percent from the third to the fourth quarter of 1998. New users choose Ebay because most of the other buyers and sellers are likely to be on Ebay's site. Although Yahoo, a leading Internet portal, also offers an online-auction service, Ebay is reported to have 11 times (1.6 million items) as many items on sale as Yahoo as of March 3, 1999 (Maubossin and Hiller, 1999).

3. Data and Descriptive Statistics

To assess the value relevance of traffic, we compile a list of 86 publicly traded pure Internet firms. We use two sources to collect an initial sample of 101 Internet firms. They include: (i) the list of top-50 Internet firms in 1998 and 1999 published by *Internet World*, a reputable weekly industry magazine that follows the Internet, and; (ii) the list of publicly traded Internet firms published in the September 1999 issue of *Business 2.0* magazine. From this initial list we exclude (i) one firm that was a non-US firm; (ii) five firms for which financial statements for any quarter were not available on the SEC's EDGAR database; (iii) five firms that were not public as of June 30, 1999 because our traffic data is available till that date; and (iv) four firms for which data on any of our independent variables (used in empirical tests reported later) were missing. Panel A of Table 1 presents a frequency distribution of firms sorted by industry type. E-commerce firms form the largest proportion of our sample (21 of 86) followed by content providers (17 of 86), portals and access providers (each 10 of 86).

We hand-collect all financial data from SEC 10-Qs for the first and second calendar quarters of 1999. We obtain traffic information for our sample firms from PC Data, a web rating agency, for the period February to June 1999.[5] PC Data tracks actual web usage information and buying patterns from more than 100,000 participants who use their computers at home, school or places of work. Every month, PC Data publishes the name of the Internet company, its rank based on two key traffic related variables, the number of unique visitors and reach%. PC Data defines unique visitors (UNIVIS) as the number of web-active individuals who visited a particular site or web company within a

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[5] PC Data began publishing traffic data since February 1999.

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given time frame. Reach% (REACH) is the number of unique users divided by the total estimated population viewing the web during the reported time period.[6] The publicly available data set is restricted to the top 500 trafficked company websites. If a public Internet firm did not figure in the top 500 web properties in a month, we code both UNIVIS and REACH for those firms as zero.[7] Because the correlation between REACH and UNIVIS was 0.97, we use REACH as the traffic measure in our empirical analyses.[8]

We use the quarterly average of REACH for our empirical analyses. Because traffic numbers for January were not available, we assume that the average REACH in January is the same as the average REACH for February and March 1999. Thus, we have average monthly REACH for the first two calendar quarters of 1999. Panel B of Table 2 presents descriptive data on REACH and a number of other independent variables used in the value-relevance analysis. It is interesting to note that the mean firm attracts 5% of the Internet population. The median firm does not attract any significant portion of the Internet population because our sample also consists of firms for which REACH is not a key factor in their business models.

4. The value relevance of traffic

4.1 Levels specification

We examine whether web traffic proxied by REACH is associated with market value of equity, after controlling for information in contemporaneous accounting book

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[6]At the current time, the estimated population being reported includes U.S. and Canadian households that are viewing the Internet using PCs with Windows 95/98/NT as their operating system. The estimated population does not currently include corporate usage.

[7] The lowest ranked web company typically has a REACH of approximately 1%. Thus, considering firms not in top 500 list to have zero REACH is not unreasonable.

[8] Given the high degree of correlation, it is not surprising that our inferences are unchanged when using the number of unique visitors as a measure of traffic.

value and earnings. We estimate the following equation using data for the first two calendar quarters of 1999:

$$MVE_{jt} = \beta_0 + \beta_1\ BVE_{jt} + \beta_2\ E_{jt} + \beta_3\ REACH_{jt} + \varepsilon_{jt} \qquad (1)$$

where

MVE_{jt} = market value of the firm j at the end of quarter t.

E_{jt} = quarter t earnings before extraordinary items for firm j.

BVE_{jt} = book value of the equity of firm j at the end of quarter t.

$REACH_{jt}$ = average monthly unique visitors as a percentage total web population during the quarter ended t for firm j.

In the absence of strong theory or priors about how REACH should be incorporated in the valuation equation, we follow Amir and Lev (1996) and incorporate REACH as a linear additive value driver.[9]

We estimate equation (1) as a pooled cross-sectional regression. Results of the estimation are presented in Table 2. Because of potential heteroskedasticity problems we consider two alternative deflators, total assets and equity book values, for estimating equation (1).[10] Results of estimation using total assets (book value) deflation is reported in Panel A (Panel B) of Table 2. We conduct the regression in stages to facilitate our understanding of the incremental relevance of financial and nonfinancial measures.

In the first stage we consider only the financial variables. We find that the coefficient on earnings is negative and insignificant. This is not very surprising because

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[9] To examine whether traffic is non-linearly related to firm value, we use $REACH^2$ instead of REACH and find similar results.

[10] Note that the intercept in equation (1) is deflated as well. As a sensitivity check, we also estimate the valuation relation without using a deflator and find similar results.

most of the companies report negative earnings. The coefficient on book value is consistently positive and statistically significant under both deflators. While with the total assets deflation the explanatory power of financial variables is 29%, under the book value deflation the explanatory is only about 1%.

Next, we examine the incremental importance of our traffic measure REACH. In both regressions, we find that the coefficient on REACH is positive and significantly associated with stock prices under both total assets (coefficient = 74.139, $p < 0.01$) and book value (coefficient = 128.177, $p < 0.01$) deflations. More important, REACH provides significant incremental explanatory power (about 13%) for stock prices beyond that provided by financial measures in both specifications. Notwithstanding the inclusion of REACH the coefficient on book value is still positive and statistically significant. Thus, while traffic explains a significant portion of the cross-sectional variation in stock prices, we cannot dismiss the relevance of financial information.

The conventional value relevance tests described above suffer from two important limitations. First, traffic is assumed to be exogenous in estimating the valuation equation. Thus, the results from valuation relation (1) do not address why firms would not increase traffic to higher levels to achieve higher equity market values. Second, it is quite likely that REACH and MVE may be simultaneously determined especially because media attention on high equity market values of some Internet companies could have generated traffic to the company's web site. We attempt to address these limitations in the following sections.

4.2. Traffic as a choice variable

4.2.1 Determinants of Traffic

As mentioned earlier, an implicit assumption behind the valuation equation (1) is that traffic is not a choice variable for firms (Ittner and Larcker, 1998; Lambert, 1998; Nagar, 2000). If greater traffic results in greater market value, the result raises the question as to why managers do not increase traffic even further to increase firm market value. Surely, there must be costs or constraints associated with increasing traffic. As Ittner and Larcker (1998) point out in their paper on the value-relevance of customer satisfaction:

> "The issue of endogeneity (between customer satisfaction and performance) is particularly problematic. If all firms optimally select customer satisfaction based on exogenous factors, there should be no statistical relation between performance and customer satisfaction, after controlling for the exogenous determinants" (p. 33).

In a discussion of Ittner and Larcker (1998), Lambert (1998) suggests that research on drivers of nonfinancial measures such as customer satisfaction can further our understanding of the information content of such measures. Thus, we investigate the drivers of traffic and re-assess the value-relevance of traffic after incorporating factors that determine traffic. We posit that the following factors influence traffic:

(i) Alliance with AOL: AOL or America Online is the world's largest Internet Service Provider (ISP) and portal on the Internet. A significant amount of traffic or "eyeballs" are channeled to the Internet through its ISP service. One way for firms to promote themselves online is, therefore, to enter into an advertising alliance with AOL so as to maximize their website's exposure to AOL's customer base. However, not all firms

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would choose this strategy because entering into such an alliance is costly [Forrester Research, December 1999, The Parting of Portal Seas].

To assess whether firms had an advertising alliance with AOL for the purposes of data analysis, we scan the press releases made by AOL since 1997. If an Internet firm has an advertising alliance with AOL, we code a variable AOL as one, else as zero.

(ii) Affiliate Programs: An affiliate program is a "referral" service from other websites on the Internet to the firm's website. When traffic is channeled from an associate web site to the firm's web site, the associate site earns referral fees for sales generated at the firm's site. Thus, the affiliate program leverages the capabilities of Internet without incurring any additional overhead unlike physical stores that require a large outlay of financial capital.

Information about the existence of a firm's affiliate programs is collected from the website www.referit.com. The website maintains an extensive directory of associate programs in 1586 product categories (e.g., apparel, automobile, and books) as of January 18, 2000. If a sample firm has an affiliate program, we code AFF as 1, otherwise AFF is set to zero. If a sample firm did not appear on the referit website, we scan the 10-K report of the firm to collect data about the existence of affiliate programs.[11]

(iii) Media visibility: The amount of attention that the media dedicates to a given Internet firm may be critical to generating customer traffic to the firm's website. In the off-line world, consumer traffic depends on geographical location. However, web consumers move easily and instantaneously across the Internet guided primarily by their

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[11] We did not use the actual size of the program because of the huge variation in the use of affiliate programs. Nevertheless, the tenor of our conclusions is unchanged when we use the actual size of the program instead of the dummy variable in our empirical analysis.

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awareness of firms' websites. Awareness or the "buzz" generated by media visibility thus helps generate interest and traffic among online surfers.

We measure media visibility (VIS) as the total number of articles published about the Internet firm in the "Major Newspapers" database of the *Lexis/Nexis* electronic database for quarterly periods for each firm starting from January 1999 to June 1999. We choose this database because it includes daily newspapers that reflect the focus of the current media and general public attention.

(iv) Marketing expenditures: Marketing and advertising expenditures could generate traffic to a firm's website by (a) creating awareness of and acceptance for their products or services, and (b) enabling the firm differentiate itself from its competition (Porter, 1980). We use marketing and advertising expenditures scaled by total assets at quarter-end (M&A) in our empirical analysis.

(v) Cash constraints: The above discussion suggests strategies that firms can follow to increase traffic. However, financial constraints may prevent firms from devoting infinite resources to just chase traffic. We proxy for such financial constraints by the cash holdings (defined as short term cash and cash equivalents) scaled by total assets (CASH). The greater the CASH, the larger the traffic levels that the firm can achieve.

To examine the extent to which the factors identified above influence traffic we estimate the following Tobit model:

$$REACH_{jt} = \delta_0 + \delta_1\ I\text{-}TYPE_{jt} + \delta_2\ AOL_{jt} + \delta_3\ AFF_{jt} + \delta_4\ VIS_{jt}$$
$$+ \delta_5\ M\&A_{jt} + \delta_6\ CASH_{jt} + \eta_{jt} \qquad (2)$$

We include a variable I-TYPE, a dummy variable, that takes on the value of 1 if the firm is an e-tailer, portal, access or content provider, zero otherwise to control for industry membership effects. A Tobit Regression, as opposed to an OLS regression, is

appropriate for estimating equation (2) because of the censored nature of the dependent variable i.e., firms that are not in the top 500 trafficked web companies are considered to have zero REACH.

Panel A of Table 3 provides descriptive statistics and correlation matrix of factors that determine traffic. The results of estimating the traffic model (2) are presented in Panel B of Table 3. The univariate regressions reveal that all the hypothesized independent variables in equation (2) with the exception of M&A and CASH are statistically significant at conventional levels. In particular, we find a strong positive relation (coefficient = .074, p < .05) between firm type (I-TYPE) and REACH suggesting the relative importance of web traffic for portals, content providers and e-commerce firms. However, the results of multivariate tests are quite different. The coefficient on I-TYPE becomes insignificant suggesting that other hypothesized determinants of traffic explain REACH better than industry membership. The variables VIS and CASH exhibit strong positive associations with REACH consistent with the notion that media exposure creates traffic while cash constraints restrict firms from chasing traffic. The coefficients on AOL and AFF are positive but weakly significant (0.027, p = 0.14 and 0.030, p = 0.12 respectively). To provide some evidence on the goodness of fit of the model we examine the OLS adjusted R^2 and find that the factors explain a significant variation (62%) in REACH.[12]

4.2.2 Value-relevance of traffic conditional on including factors determining traffic

Recall Ittner and Larcker (1998)'s comment that if all firms optimally select

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[12] Given that OLS produces inefficient estimates as compared to Tobit estimates, the adjusted R^2 from OLS can be viewed as a conservative estimate of the goodness of fit of the traffic model.

traffic based on exogenous factors, there should be no statistical relation between market value and traffic, after controlling for the exogenous determinants. To assess whether the value-relevance of traffic disappears after controlling for its determinants, we modify (1) as follows:

$$MVE_{jt} = \beta_0 + \beta_1 BVE_{jt} + \beta_2 E_{jt} + \beta_3 REACH_{jt} + \kappa REACH(P)_{jt} + \varepsilon_{jt} \qquad (1a)$$

where SALES represents quarter t sales and REACH(P) represents predicted values for REACH from equation (2). Thus, assuming traffic as endogenously determined by optimizing managers based on factors discussed earlier, we would expect the coefficient on REACH(P) to be positive and statistically significant. Conditional on including REACH(P), we would not expect the coefficient on REACH (β_3) to be statistically significant.

Results of estimating the revised value relevance equation (1a) are reported in Panel C of Table 3. As expected, κ is positive and statistically significant although β_3 is not. The finding that the β_3 is insignificant gives us some comfort that we have not omitted important factors in estimating equation (2).[13] Furthermore, this analysis relaxes the assumption of non-optimizing managers when considering the value-relevance of traffic. One interpretation of the results presented in Panel C is that managers may be unable to increase traffic to infinite levels because there are costs and constraints associated with such an action.[14] In other words, if an optimizing manager can increase traffic by getting a greater number of citations in the press without any change in cash balances, the consequent increase in traffic is positively valued by the stock market.

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[13] The tenor of our conclusions is unchanged if we introduce the factors that determine traffic individually instead of the predicted value of REACH in equation (1a).

[14] Nagar (2000) makes a similar interpretation in his study of the information content of customer satisfaction scores.

4.3. Simultaneity between traffic and market value

Another limitation of estimating the value relevance of traffic using the value-relevance model laid out in (1) is that traffic may not be exogenous to market value. It is quite plausible that firms with higher market values attract more traffic. To address such endogeneity concerns, we estimate the valuation equation and the traffic equation simultaneously.

$$\mathbf{MVE}_{jt} = \beta_0 + \beta_1 \, BVE_{jt} + \beta_2 \, E_{jt} + \beta_3 \, \mathbf{REACH}_{jt} + \varepsilon_{jt} \tag{1}$$

$$\mathbf{REACH}_{jt} = \delta_0 + \delta_1 \, I\text{-}TYPE_{jt} + \delta_2 \, AOL_{jt} + \delta_3 \, AFF_{jt} + \delta_4 \, VIS_{jt} \\ + \delta_5 \, M\&A_{jt} + \delta_6 \, CASH_{jt} + \delta_7 \, \mathbf{MVE}_{jt} + \eta_{jt} \tag{2a}$$

Equation (1) is estimated using OLS while equation (2a) is estimated as a Tobit regression.

Results of estimating equations (1) and (2a) simultaneously are presented in Table 4. As before, we consider both total assets and book value of equity as deflators for the market value regression. The results from estimating the traffic regression (2a) reveal potential endogeneity between REACH and MVE because of the significant coefficient on MVE in both specifications. The addition of MVE to equation (2a) changes some of the earlier results related to the determinants of traffic. In particular, the significance levels of the coefficients on affiliate programs proxy (AFF) and alliance with AOL are now strengthened. The variables VIS and CASH continue to remain strongly associated with REACH. Most important, REACH remains significantly value-relevant even after accounting for the endogeneity between REACH and MVE in both specifications.

4.4. Returns analysis

To control for omitted variable problems that are typical to levels analysis such as the one in equation (1) above, we estimate the following returns regression to check for the robustness of the value-relevance of traffic:

$$\text{Ret}_{jt} = \beta_0 + \beta_1 E_{jt} + \beta_2 \Delta E_{jt} + \beta_3 \%\Delta REACH_{jt} + v_{jt} \tag{3}$$

where

Ret_{jt} = stock return of firm j for quarter t.

ΔE_{jt} = change in quarter t's earnings deflated by beginning of quarter t's market value

$\%\Delta REACH_{jt}$ = percentage change in REACH for quarter t.

Table 5 reports the results of estimating equation (3). We find that the coefficient on percentage change in REACH is positive and statistically significant (coefficient = 1.52, p-value < 0.01). Thus, the value relevance of REACH documented before is not likely to be due to omitted correlated variables. However, in contrast to the levels regression, we do not find financial measures, namely earnings levels and earnings changes, to be value-relevant.

5. Impact of traffic on revenues

Having demonstrated that traffic is a value-driver, we next examine whether traffic is value-relevant because of a fundamental relationship between web traffic and revenues, which by itself may be value-relevant. Anecdotal evidence suggests that because many Internet firms report negative earnings, analysts and the investment community often use price to revenues ratio for pricing securities. Thus, one plausible explanation for observing an association between traffic and stock prices is that it

provides information about sales revenues and growth. After all, firms attract web traffic to generate current and future revenue by selling goods, services and advertisements.

We conduct two tests to test this explanation. First, we examine whether traffic is value-relevant incremental to information contained in revenues (SALES). We modify equation (1) as follows:

$$MVE_{jt} = \beta_0 + \beta_1 \, BVE_{jt} + \beta_2 \, E_{jt} + \beta_3 \, REACH_{jt} + \beta_4 \, SALES_{jt} + \varepsilon_{jt} \qquad (1b)$$

where SALES represents sales revenue for quarter t. As before, we estimate the valuation equation using both book value and total assets deflators.

Results presented in Panel A of Table 6 suggest that sales revenue is positively associated with stock prices. Despite the inclusion of SALES as an additional variable, REACH continues to be significantly related to market value.[15] Thus, REACH and SALES appear to capture different aspects of market values of Internet firms. However, this does not preclude the possibility that REACH is related to fundamental variables such as sales revenues. We explore this possibility by conducting more direct tests of the relation between traffic and revenues and revenue growth.

We examine the effect of traffic on revenues and growth in revenues by estimating the following four models:

$$SALES_{jt} = \gamma_0 + \gamma_1 \, REACH_{jt} + \gamma_3 \, ASSETS_{jt} + \varphi_{jt} \qquad (4)$$

$$SALES_{jt} = \gamma_0 + \gamma_1 \, REACH_{jt} + \gamma_2 \, SALES_{j,t-1} + \varphi_{jt} \qquad (5)$$

$$\%\Delta SALES_{jt} = \gamma_0 + \gamma_1 \, REACH_{jt} + \varphi_{jt} \qquad (6)$$

$$\%\Delta SALES_{jt} = \gamma_0 + \gamma_1 \, \%\Delta REACH_{jt} + \varphi_{jt} \qquad (7)$$

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[15] We also estimate a returns regression (i.e., modify equation (3)) after including change in sales scaled by lagged market value as an additional variable and find similar results.

where ASSETS is total assets at the end of quarter t.

Our first model (equation (4)) examines whether more traffic to websites results in higher sales after controlling for size effects (proxied by total assets). This model, however, ignores time-series trends in revenues. Hence, to explicitly control for time-series correlation in sales we consider model (5). Model (6) can be interpreted as a test of whether web traffic affects the growth or persistence of the revenue stream (see Ittner and Larcker, 1998). Finally, model (7) is a changes version of model (4) that checks for robustness of results due to omitted variable bias.

Results of estimating the four models are presented in Panel B of Table 6. Estimation results of equation (4) suggest that the coefficient on REACH is positive and highly significant (coefficient 89.707, $p < 0.05$). This implies that attracting more web traffic results in higher sales after controlling for size effects. However, when we control for time trends by including lagged revenues the coefficient on REACH becomes statistically insignificant. The results of estimating (6) suggest that REACH does not impact the persistence of revenue stream. Results from estimating equation (7) show that the percentage change in REACH is not significantly related to percentage change in revenues. This indicates that the relation between REACH and SALES is not robust to alternative specifications.

Overall, our findings provide weak support at best for the hypothesis that web traffic impacts current revenues or revenue growth. Our inferences remain unchanged after conducting two sensitivity checks. First, we examine whether REACH impacts revenues with a lag by re-estimating equations (4), (5) and (6) with REACH for quarter t-1 instead of quarter t. Second, we re-estimate all the above models after deleting

observations for industries where traffic may be less important, i.e., firms for whom I-TYPE is set to zero.

6. Acquisition prices and web traffic

Robust evidence on the value-relevance of web traffic incremental to information in current sales coupled with the lack of consistent associations between web traffic and revenues suggests that web traffic captures certain value attributes that may not have an immediate impact on operational performance. As argued earlier, it is plausible that web traffic creates significant intangible benefits in the form of network effects and potential customer relationships that will eventually result in improved revenues and revenue growth.[16]

To provide further evidence on the importance of traffic as a value-driver, we examine an alternative value indicator, i.e., acquisition prices in web mergers and acquisitions. We obtain a sample of 42 acquisitions of Internet companies during the year ended September 1999 for which traffic information is also available. Because many of the acquired firms are privately-held we are unable to obtain financial data for them. We use the actual number of unique visitors as our proxy for web traffic to facilitate an intuitive interpretation of the price paid by acquiring firms for each unique visitor of the target firms' web sites.

Descriptive statistics and results of regression of acquisition prices on the number of monthly unique visitors acquired are provided in Table 7. We find that acquiring firms pay a mean (median) price of $167 ($109) per monthly unique visitor (see Panel A).

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[16] Some recent acquisitions such as the Excite@home acquisition of Bluemountainarts.com suggest that acquiring firms pay significant sums for website traffic even if the target has no revenues.

Also, target firms' traffic numbers account for a significant (77%) of the cross sectional variation in acquisition prices consistent with the hypothesis that the market for corporate control values future growth potential and network effects from additional customer traffic (see Panel B). The strong explanatory power of the regression suggests that firm-level financial information (such as book value or earnings) that are not available to us may not be as value relevant for explaining acquisition prices. To control for potential skewness in acquisition values, we estimate the relationship using logarithmic transformation of the variables and find consistent results (see Panel C).

7. Concluding remarks

In this study we explore the role of both financial and nonfinancial measures for Internet firm values. Our findings indicate that a key nonfinancial measure, web traffic, explains a substantial portion of cross-sectional differences in equity values of Internet firms. This result obtains after controlling for traditional financial measures such as earnings and equity book values. Our results are robust to controlling for factors that determine traffic and potential endogeneity of the traffic measure.

Although traffic is highly value-relevant, we find only weak and insignificant relations between traffic and current sales levels and sales growth. We conjecture that the capital market participants value potential network effects and customer relationships that traffic brings even though such traffic does not necessarily result in current sales. To provide preliminary evidence on this conjecture we examine the relation between acquisition prices and web traffic for a sample of Internet acquisitions in 1999. Our results indicate a strong relation between acquisition prices and web traffic. Acquirers pay a significant price ($167 per web visitor, on average) for traffic. While this result is

by no means concrete evidence of the importance of potential network effects that firms can create with such traffic, more direct tests can be conducted when enough time-series observations of Internet firm financial performance becomes available.

There are several limitations to our analyses. First, although our paper is responsive to recent calls for economic models of firm value that incorporate non-financial measures (Amir and Lev, 1996; Shevlin, 1996; Lambert, 1998), our model positing the factors that explain traffic could be potentially improved. Future work could focus on building better models to explain traffic generation. Second, our REACH measures could be subject to measurement error because PC Data's survey of web users does not include corporate users. Third, our analysis is limited to traffic measures. Research using a broader set of non-financial measures may provide greater insight into other factors that explain variation in Internet firm values.

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Table 1

Descriptive Statistics

Panel A: Internet Firms by Type

Type	Industry	No. of firms
1.	Access providers	10
2.	Content providers	17
3.	Software vendors	7
4.	Portals	10
5.	E-commerce	21
6.	Infrastructure providers	3
7.	Advertising agencies	6
8.	Security	6
9.	Business to Business	4
10.	Miscellaneous	2
	Total	86

Panel B: Descriptive statistics

Variable	N	Mean	Std.dev.	Median	1st quartile	3rd quartile
REACH	149	0.05	0.10	0.00	0.00	0.05
UNIVIS (million)	149	6.06	12.62	0.00	0.00	6.52
E ($ million)	149	-10.99	44.65	-6.19	-17.25	-2.14
BVE ($ million)	149	223.21	642.44	112.06	54.84	185.55
ASSETS ($ million)	149	425.05	870.61	163.36	74.97	416.65
SALES ($ million)	149	33.51	44.96	19.58	6.53	42.27
MVE ($ million)	149	3525.41	8903.87	908.87	452.01	2664.93
MVBV	143	17.92	36.24	8.88	5.07	16.21

Notes:
1. Variables are defined as follows: REACH = the average proportion of unique visitors to total web population during a quarter, UNIVIS = the average monthly unique visitors during a quarter, E = income before extraordinary items, ASSETS = total assets, BVE = book value of equity, SALES = sales revenues, MVE = market value of equity, MVBV = market to book ratio.
2. We compute market to book ratio only where book value of equity is greater than zero.

Table 2

Summary statistics for the regression of market values on financial and nonfinancial measures

$$MVE_{jt} = \beta_0 + \beta_1\ BVE_{jt} + \beta_2\ E_{jt} + \beta_3\ REACH_{jt} + \varepsilon_{jt} \tag{1}$$

Panel A: Total assets deflation

					(N=149)
Variable	**Pred. Sign**	**Coeff. Estimate**	**t-stat**	**Coeff. Estimate**	**t-stat**
Intercept	?	11.552	1.00	6.502	0.81
E	+	-0.151	-0.02	-2.230	0.35
BVE	+	13.698	5.82*	9.146	5.12*
REACH	+			74.139	3.56*
Adj. R^2		28.88%		42.09%	

Panel B: Book value of equity deflation

					(N=143)
Variable	**Pred. Sign**	**Coeff. Estimate**	**t-stat**	**Coeff. Estimate**	**t-stat**
Intercept	?	-11.481	-0.61	-9.134	-0.52
E	+	-24.448	-0.73	-27.014	-0.83
BVE	+	15.509	5.88*	8.966	2.57*
REACH	+			128.177	2.74*
Adj. R^2		0.89%		13.45%	

Notes:
1. ***/**/* represents one-tailed significance at 10%, 5%, and 1% respectively. Reported t-statistics are adjusted for White's (1980) correction.
2. Variables are defined as follows: MVE = market value of equity, E = income before extraordinary items, BVE = book value of equity, REACH = the average proportion of unique visitors to total web population during a quarter.
3. All the variables (including the intercept) except REACH are appropriately deflated.

Table 3

Regression results of estimating the valuation equation after controlling for determinations of web traffic

Panel A: Descriptive Statistics

Variable	N	Mean	Std.dev.	Median	1st quartile	3rd quartile
VIS	149	24.75	60.60	7.00	3.00	20.00
M&A	149	0.06	0.06	0.05	0.03	0.08
CASH	149	0.41	0.28	0.36	0.19	0.62

Panel B: Tobit regression analysis of cross-sectional differences in web traffic

$$REACH_{jt} = \delta_0 + \delta_1\ I\text{-}TYPE_{jt} + \delta_2\ AOL_{jt} + \delta_3\ AFF_{jt} + \delta_4\ VIS_{jt} + \delta_5\ M\&A_{jt} + \delta_6\ CASH_{jt} + \eta_{jt}\ (2)$$

(N=149)

Variable	Pred. Sign	Univariate Results Coeff. Estimate	Univariate Results χ^2-stat	Multivariate Results Coeff. Estimate	Multivariate Results χ^2-stat
Intercept	?	--	--	-0.117	13.41*
Type	+	0.074	3.71**	0.000	0.00
AOL	+	0.103	6.45*	0.027	1.20
AFF	+	0.066	2.56**	0.030	1.38
VIS	+	0.002	100.90*	0.002	100.57*
M&A	+	-0.279	0.97	0.037	0.04
CASH	+	0.037	0.35	0.118	8.55*
OLS Adj. R^2				62.40%	

Panel C: Value relevance of traffic after controlling for determinants of traffic

$$MVE_{jt} = \beta_0 + \beta_1\ BVE_{jt} + \beta_2\ E_{jt} + \beta_3\ REACH_{jt} + \kappa\ REACH(P)_{jt} + \varepsilon_{jt} \qquad (1a)$$

Variable	Pred. Sign	Total Assets deflation (N=149) Coeff. Estimate	Total Assets deflation (N=149) t-stat	Book value deflation (N=143) Coeff. Estimate	Book value deflation (N=143) t-stat
Intercept	?	9.037	1.44***	4.427	0.43
E	+	-2.680	-0.43	-15.715	-0.76
BVE	+	13.548	3.94*	22.826	3.99*
REACH	?	20.393	0.79	-78.976	-1.11
REACH(P)	+	70.985	2.00**	265.842	6.72*
Adj. R^2		46.96%		35.93%	

Table 3 (continued…)

Notes:
1. ***/**/* represents one-tailed significance at 10%, 5%, and 1% respectively.   Reported t-statistics are adjusted for White's (1980) correction.
2. Variables are defined as follows: REACH = the average proportion of unique visitors to total web population during a quarter, I-Type = 1, if the firm is either a portal, e-commerce firm or access/content provider, zero otherwise, AOL = 1, if the firm has an alliance with America Online, zero otherwise, AFF = 1, if the firm has affiliate programs, zero otherwise, VIS = media visibility measured as the number of articles in leading newspapers and magazines, M&A = marketing and advertisement expenditures scaled by total assets, CASH = cash and cash equivalents scaled by total assets, MVE = market value of equity, E = income before extraordinary items, BVE = book value of equity, SALES = sales revenues, REACH(P) = predicted value of REACH from equation (2).
3. All the variables in equation (1a) (including the intercept) except REACH and REACH(P) are appropriately deflated.

Table 4

Regression results of estimating the valuation equation after accounting for the simultaneity between market value and web traffic

$$\text{REACH}_{jt} = \delta_0 + \delta_1 \text{ I-TYPE}_{jt} + \delta_2 \text{ AOL}_{jt} + \delta_3 \text{ AFF}_{jt} + \delta_4 \text{ VIS}_{jt}$$
$$+ \delta_5 \text{ M\&A}_{jt} + \delta_6 \text{ CASH}_{jt} + \delta_7 \mathbf{MVE}_{jt} + \eta_{jt} \tag{2a}$$

Variable	Pred. Sign	Total Assets deflation (N=149)		Book value deflation (N=143)	
		Coeff. Estimate	χ^2-stat	Coeff. Estimate	χ^2-stat
Intercept	?	-0.130	15.40*	-0.078	3.70**
I-TYPE	+	0.007	0.08	-0.036	1.05
AOL	+	0.028	1.32	0.073	3.72**
AFF	+	0.038	2.21***	0.106	4.05**
VIS	+	0.001	5.53*	0.004	6.84*
M&A	+	-0.248	1.00	0.210	0.69
CASH	+	0.104	6.60*	0.151	12.23*
MVE	+	0.004	2.75**	-0.007	2.67***
OLS Adj. R^2		62.63%		62.17%	

$$\text{MVE}_{jt} = \beta_0 + \beta_1 \text{ BVE}_{jt} + \beta_2 \text{ E}_{jt} + \beta_3 \mathbf{REACH}_{jt} + \varepsilon_{jt} \tag{1}$$

Variable	Pred. Sign	Total Assets deflation (N=149)		Book value deflation (N=143)	
		Coeff. Estimate	t-stat	Coeff. Estimate	t-stat
Intercept	?	4.281	0.51	39.867	1.61***
E	+	-6.464	-0.97	-21.753	-0.90
BVE	+	14.238	7.07*	13.743	5.18*
REACH	+	85.135	13.95*	171.560	2.74*
Adj. R^2		47.20%		24.61%	

Notes:

1. ***/**/* represents one-tailed significance at 10%, 5%, and 1% respectively. Reported t-statistics are adjusted for White's (1980) correction.

2. Variables are defined as follows: REACH = the average proportion of unique visitors to total web population during a quarter, I-Type = 1, if the firm is either a portal, e-commerce firm or access/content provider, zero otherwise, AOL = 1, if the firm has an alliance with America Online, zero otherwise, AFF = 1, if the firm has affiliate programs, zero otherwise, VIS = media visibility measured as the number of articles in leading newspapers and magazines, M&A = marketing and advertisement expenditures scaled by total assets, CASH = cash and cash equivalents scaled by total assets, MVE = market value of equity, E = income before extraordinary items, BVE = book value of equity.

3. All the variables in equation (1) (including the intercept) except REACH are appropriately deflated. MVE in equation (2a) is also appropriate scaled.

Table 5

Regression results of the association between stock returns and financial and nonfinancial measures

$$Ret_{jt} = \beta_0 + \beta_1 E_{jt} + \beta_2 \Delta E_{jt} + \beta_3 \%\Delta REACH_{jt} + \nu_{jt} \qquad (3)$$

(N=88)

Variable	Pred. Sign	Coeff. Estimate	t-stat
Intercept	?	0.217	2.30**
E	+	2.912	0.98
ΔE	+	1.535	0.60
%ΔREACH	+	1.516	3.02*
Adj. R^2		2.40%	

Notes:
1. ***/**/* represents one-tailed significance at 10%, 5%, and 1% respectively. Reported t-statistics are adjusted for White's (1980) correction.
2. Variables are defined as follows: Ret = stock return over quarter, E = income before extraordinary items (scaled by lagged market value of equity), ΔE = change in income before extraordinary items (scaled by lagged market value of equity) for the quarter, %ΔREACH = percentage change in average proportion of unique visitors to total web population during a quarter.

Table 6

Regression results examining the relation between web traffic, revenues and stock prices

Panel A: Value-relevance of traffic after controlling for revenues

$$MVE_{jt} = \beta_0 + \beta_1 \ BVE_{jt} + \beta_2 \ E_{jt} + \beta_3 \ REACH_{jt} + \beta_4 \ SALES_{jt} + \varepsilon_{jt} \tag{1b}$$

Variable	Pred. Sign	Total Assets deflation (N=149)		Book value deflation (N=143)	
		Coeff. Estimate	t-stat	Coeff. Estimate	t-stat
Intercept	?	11.460	1.16	-27.584	-0.84
E	+	2.892	0.36	-10.408	-0.44
BVE	+	7.107	5.13*	8.212	2.12**
REACH	+	74.706	3.61*	126.477	2.89*
SALES	+	12.981	1.87**	8.922	1.49***
Adj. R^2		43.56%		18.43%	

Panel B: Relation between traffic and revenue and revenue growth

Sales levels on traffic levels regression

$$SALES_{jt} = \gamma_0 + \gamma_1 \ REACH_{jt} + \gamma_3 \ ASSETS_{jt} + \varphi_{jt} \tag{4}$$

			(N=149)
Variable	Pred. Sign	Coeff. Estimate	t-stat
Intercept	?	19.057	5.17*
REACH	+	89.707	2.31**
ASSETS	+	0.024	2.22**
Adj. R^2		26.79%	

Sales levels on traffic levels regression controlling for time series trends in sales

$$SALES_{jt} = \gamma_0 + \gamma_1 \ REACH_{jt} + \gamma_2 \ SALES_{j,t-1} + \varphi_{jt} \tag{5}$$

			(N=111)
Variable	Pred. Sign	Coeff. Estimate	t-stat
Intercept	?	3.743	2.96*
REACH	+	7.948	0.71
$SALES_{t-1}$	+	1.081	17.09*
Adj. R^2		92.45%	

Table 6 (continued…)

Sales changes on traffic Levels regression

$$\%\Delta SALES_{jt} = \gamma_0 + \gamma_1\ REACH_{jt} + \varphi_{jt} \qquad\qquad (6)$$

			(N=111)
Variable	**Pred. Sign**	**Coeff. Estimate**	**t-stat**
Intercept	?	0.421	3.46*
REACH	+	-0.277	-1.21
Adj. R^2		-0.84%	

Sales changes on traffic changes regression

$$\%\Delta SALES_{jt} = \gamma_0 + \gamma_1\ \%\Delta REACH_{jt} + \varphi_{jt} \qquad\qquad (7)$$

			(N=66)
Variable	**Pred. Sign**	**Coeff. Estimate**	**t-stat**
Intercept	?	0.264	4.48*
%ΔREACH	+	0.869	0.75
Adj. R^2		-1.52%	

Notes:
1. ***/**/* represents one-tailed significance at 10%, 5%, and 1% respectively. Reported t-statistics are adjusted for White's (1980) correction.
2. Variables are defined as follows: MVE = market value of equity, E = income before extraordinary items, BVE = book value of equity, SALES = sales revenues, SALES = sales revenues, %ΔSALES = percentage change in sales revenues, REACH = the average proportion of unique visitors to total web population during a quarter, %ΔREACH = percentage change in REACH.
3. All the variables in equation (1b) (including the intercept) except REACH are appropriately deflated.

Table 7

Results relating acquisition prices and web traffic

Panel A: Descriptive statistics

				(N=42)	
Variable	**Mean**	**Std.dev.**	**Median**	**1st quartile**	**3rd quartile**
Acquisition price ($ million)	345.07	1114.42	45.00	11.00	166.00
Unique monthly visitors (millions)	2.06	3.87	0.45	0.20	2.10
Price per unique monthly visitor	167.47	191.45	109.15	38.21	214.06

Panel B: Coefficient estimates from regressing acquisition prices on unique visitors

Dependent variable: Acquisition price

			(N=42)
Variable	**Pred. Sign**	**Coeff. Estimate**	**t-stat**
Intercept	?	-164.742	-2.37*
Unique visitors	+	266.799	4.28*
Adj. R^2		76.57%	

Dependent variable: Log(Acquisition price)

			(N=42)
Variable	**Pred. Sign**	**Coeff. Estimate**	**t-stat**
Intercept	?	4.471	20.20*
Log(Unique visitors)	+	0.865	6.89*
Adj. R^2		50.12%	

Note: ***/**/* represents one-tailed significance at 10%, 5%, and 1% respectively. Reported t-statistics are adjusted for White's (1980) correction.