The role of the Internet in changing industry competition

Fang Wang a, *, Xiao-Ping (Steven) Zhang b

a School of Business and Economics, Wilfrid Laurier University, 75 University Avenue West, Waterloo, Ontario, Canada N2L 3C5
b Department of Electrical and Computer Engineering, Ryerson University, 350 Victoria Street, Toronto, Ontario, Canada M5B 2K3

A R T I C L E   I N F O

Article history:
Received 2 October 2012
Received in revised form 29 July 2014
Accepted 9 October 2014
Available online 22 October 2014

Keywords:
Internet
Industry competition
Winner-take-all
Herfindahl–Hirschman index
Industry profitability
Cross-sectional analysis
Sector heterogeneity

A B S T R A C T

Does the Internet lead to a more competitive industry or market? The popular view asserts that the Internet intensifies competition, but competing theories challenge this view, indicating the need for empirical support. This research examines the role of the Internet in changing the overall industry competition as measured by the Herfindahl–Hirschman index (HHI), industry profitability, the new entry ratio, and the ratio of firm number change. The results reveal significantly positive relationships between Internet use and change in the HHI and industry profitability and significantly negative relationships between Internet use and the new entry ratio and the ratio of firm number change. These findings suggest that instead of increasing industry competition, Internet use results in less competitive industry structures.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

Does the Internet change industry competition? More specifically, does it lead to a more or less competitive market? This is a critical question for organizations, with significant strategic and managerial implications. The role of the Internet received wide discussion among academic researchers and industry managers around the turn of the millennium, and several important articles (e.g., [5,15,23,25,34]) were published between 1997 and 2005.

The main debate in this discussion asserts that the Internet intensifies competition. Theoretically, Porter [34] offers representative arguments by summarizing how the Internet changes industry competition through five forces. Practically, the apparent price competition online, which drew much attention from the public and was confirmed by several studies [8,9,26], was used as evidence to support this view. For example, Brynjolfsson and Smith [9] found that prices on the Internet were 9–16% lower than prices in conventional outlets, and retailers’ price adjustments were up to 100 times smaller than conventional retailers’ price adjustments.

Since then, the view that the Internet intensifies competition has been widely accepted in the business world and has shaped strategic business discussions and the direction of academic research. Firms seek strategic responses to the intensified competition brought by the Internet. For example, in his discussion on competitive advantage, Porter [34] suggests that firms can no longer sustain operational effectiveness and instead must gain and rely on a distinct strategic positioning. A great deal of research attention has been given to strategies that help firms survive and combat the intensified competition online, such as online pricing strategy [15,25], product offering strategy [5], relationship marketing [45,11], and tools such as Internet shopping agents [23].

Despite the popular belief that the Internet intensifies competition, competing theories suggest different answers. For example, economists suggest that the broad, fast communication and easy replication enabled by the Internet ultimately create a winner-take-all society [18] or a superstar effect [39]—that is, the Internet makes customers converge in their tastes and buying habits, and popular products become disproportionately profitable. Following this school of thought, Elberse [17] tests the long-tail theory (i.e., the Internet changes the shape of the demand curve in favor of niche products [3]) by examining sales patterns in the music and home-video industries. She finds that the “tail” of merchandise assortments becomes longer, but flatter, while an ever smaller set of top titles/products continues to account for a large market share. That is, the superstar effect [39] dominates over the long-tail effect [3] in the online music and home-video industry.

The winner-take-all theory, when applied to industry competition analysis, implies that the Internet helps strengthen the position
of industry winners further, thus reducing the competitive power of smaller or weaker competitors. This could lead to a less competitive market.

Because different theories lead to different answers, we need to determine which phenomenon plays out in the market. Previous studies on price competition on the Internet do not provide strong evidence to support the intensified competition because (1) price is only one perspective of competition and does not reflect the change in the industrial competitive structure (i.e., it is not clear if and how price competition changes firm market share and market power) and (2) firms cannot endlessly reduce price; thus, the result of price competition is price standardization. Most firms now realize that Internet competition is not solely about price competition. After more than a decade of Internet diffusion in business practice, many industry changes caused by the Internet have been realized. Many firms/industries have developed relatively mature Internet strategies. Thus, an examination of the industry changes caused by the Internet is now feasible.

To understand the effect of the Internet on industry competition, this research employs two widely used industry competition measures—that is, the Herfindahl–Hirschman index (HHI) and industry profitability—supplemented by the new entry ratio and the ratio of firm number change to examine industry competition change over the years. The average firm inlink count of an industry serves as the proxy of Internet use in the industry. We find significantly positive relationships between Internet use and change in the HHI and industry profitability and significantly negative relationships between Internet use and the new entry ratio and the ratio of firm number change. These results consistently and strongly suggest that Internet use results in less competitive industries. The additional exploratory study indicates the sector heterogeneity (i.e., the effect size of Internet use on competition changes varies across industry sectors).

To the best of our knowledge, this research is the first to provide empirical evidence on how the Internet changes industry competition from the industrial structure perspective. Our finding that the Internet leads to less industrial competition contradicts the widely held theoretical assumption and supports the winner-take-all theory. This finding is important in shaping how firms and academics view the Internet in business practices and evaluate Internet-induced changes in industry structures.

In the following sections, we first briefly review competition concept and measures, compare the competing theories on the Internet's effect on competition, and introduce our hypotheses. We then discuss the research methodology and present the analysis results. Finally, we discuss the research contributions and limitations and offer future research directions.

2. Theoretical background

2.1. Competition

Competition is a central concept in economics and business analysis. It is “a rivalry between individuals (or groups or nations), and it arises whenever two or more parties strive for something that all cannot obtain” [42]. Competition comes with many forms (e.g., market trading, auctions), instruments (e.g., prices, advertising, R&D, effort levels), and objects (e.g., profits, market share, corporate control) [44]. Thus, competition on one instrument (i.e., price competition) cannot represent the overall industry competition level.

Classical economic theories distinguish several levels of competition, from perfect competition (i.e., a theoretical market structure that features no barriers to entry, an unlimited number of sellers and buyers, and a perfectly elastic demand curve), to monopolistic competition (i.e., a large number of firms, each with a small market share and slightly differentiated products), to oligopoly (i.e., a market with a small number of sellers controlling the majority of market share), to monopoly (i.e., one seller controlling the market) [32]. Overall, competition intensity is interpreted through firm market power and industry profitability [6,32,33,44]. Market power is the extent to which individual firms can influence market price or other terms on which their products are sold [32]. The more competitive the market, the less power an individual firm has to influence the market. A perfectly competitive market contains many firms, such that an individual firm has no power to influence the market. Consequently, each firm must accept the market terms set by the forces of market demand and supply. The state of competition determines industry profitability [33]. In highly competitive industries, such as tires and metal cans, profitability is low.

In the empirical economic and strategy literature, concentration ratios and profit margins are the two most popular types of measures for competition intensity. Concentration ratios measure the distribution of production across firms within an industry and reflect market power and competition intensity [14,20,19,29,32,37,10]. Concentrated industries, in which a few firms control a large market share, are thought to earn abnormal profits because barriers to entry thwart new entrants, and existing firms can more easily collude. In practice, the concentration ratio HHI is widely applied in competition law, antitrust cases, and technology management [33]. Profit margins are a performance measure, indicating the result of competition. High competition results in low industry profitability [38].

Industry competition is driven by market structure elements, such as firm number, entrance or exit barrier, and product differentiation [32], or in strategy literature, five competitive forces [33]. In the Information Age, the Internet is considered a new and powerful factor that affects industry competition [34].

2.2. Internet and competition

Table 1 summarizes two competing theories that explain the effect of the Internet on industry competition. First, Porter’s [34] analysis on five forces of industry competition suggests that, in general, the use of the Internet intensifies the rivalry among competitors. Second, the winner-take-all theory suggests that the Internet helps industry winners further strengthen their

<table>
<thead>
<tr>
<th>Theories</th>
<th>Key logic</th>
<th>Effects of the Internet on industrial competitive structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porter's five forces</td>
<td>The Internet intensifies the rivalry among competitors, brings more companies into competition, and migrates competition to price</td>
<td>More competitive structures</td>
</tr>
<tr>
<td>Winner-take-all</td>
<td>Because fast communication makes customers converge in their tastes and buying habits, a small advantage over competitors can be rewarded by a large market share. The Internet helps strengthen the competitive positions of a selected group of winners and reduce the competition power of small and/or weak firms</td>
<td>Less competitive structures</td>
</tr>
</tbody>
</table>
competitive positions and reduces the competitive power of smaller or weaker competitors, leading to a less competitive industry structure.

2.2.1. Porter’s five forces

Many researchers have analyzed the effect of the Internet on industry competition by focusing on specific perspectives of competition. Porter’s [34] analysis on Internet changes to industry forces represents this approach. With his five forces framework, Porter identifies specific changes the Internet may instigate, including the bargaining power of suppliers, the bargaining power of buyers, rivalry among existing competitors, barriers to entry, and the threat of substitute products or services. Although some trends are positive (e.g., the Internet can expand market size and improve products’ positions relative to traditional substitutes), most trends are negative, leading to a more competitive industry structure. Porter suggests that “it would be a mistake to draw general conclusions” because “the strength of each of the five forces varies considerably from industry to industry” (p. 5). However, with the greater number of negative trends than positive trends and his emphasis on reduced entry barriers and increased rivalry among competitors (i.e., the reduced differences among competitors, the additional competition on price, the increased number of competitors, and the increased pressure for price discounting), Porter’s view is in line with the economic view that the Internet is a great equalizer that leads to a more competitive and efficient market [40].

2.2.2. Winner-take-all theory

The economists Robert Frank and Philip Cook use the winner-take-all concept in their 1996 book The Winner-Take-All Society [18]. This book discusses the contemporary trend toward concentrated wealth to very few winners and explains the phenomenon partly by the modern structure of markets and technology. Specifically, human beings are inherently social, and broad, fast communication causes customer tastes and buying habits to converge. Meanwhile, with the Internet’s high fixed cost and low marginal cost structure, brick sellers can gain huge advantages with digital channels.

This school of thought has sparked research attention in the strategy field in recent years. For example, Noe and Parker [31] use the winner-take-all theory to explain the highly skewed profitability of Internet firms and the aggressive marketing spending of web-based firms. Elberse [17] lends support to this theory over the long-tail theory by reporting evidence of changes in the product distribution curve on the Internet, or the superstar effect. That is, there is an increase in concentration in ever fewer best-selling titles at the head of the distribution curve, and the tail becomes longer but also flatter.

The winner-take-all theory can be used to analyze industry competitive structures. Network effects and customer-to-customer communications, as used in many e-businesses and social media cases today, support the logic of converged customer tastes and buying habits. Most firms now leverage the use of their websites in customer communications and services because of the benefits of low marginal cost structures and customized communications. Certain firms will become winners of e-businesses, and these winners will have advantages in taking market shares from competitors. If so, most industries will witness increasing industry concentrations or, in the economic sense, a less competitive structure.

3. Hypotheses

Because extant theories suggest different answers to our question (i.e., whether and how the Internet changes industry competition) and no empirical evidence exists, we test the following competing hypotheses:

**H₀.** The change of industry competition is not associated with Internet use.

**H₁.** The change of industry competition is positively associated with Internet use.

**H₂.** The change of industry competition is negatively associated with Internet use.

In addition, we are interested in exploring the potential sector heterogeneity of the relationship between Internet use and industry competition change. That is, does the effect of Internet use on industry competition change differ across industry sectors such as manufacturing, wholesale, retail, and services? Because little theoretical discussion on the topic exists in the literature, we leave this as an empirical issue in our exploratory study.

4. Methodology

4.1. Model formulation

In this study, we conduct cross-sectional regressions to examine the relationship between Internet use and changes in industry competition from 1997 to 2010. To confirm the results, we repeat the study for the 1997–2006 and 1997–2011 periods. We consider the fiscal year of 1997 in our analysis because it is the year when industries began adopting Internet technologies. We use the four-digit Standard Industrial Classification (SIC) to define industries in our analysis. We examine the following:

\[
\Delta \text{Competition}_i = f(\text{Internet}_i, \text{Control variables}),
\]

where \(\Delta \text{Competition}_i\) is the change in industry competition and Internet, is a quantitative measure of Internet use in an industry. Table 2 summarizes all variables.

4.2. The measure of (change in) industry competition

We examine four competition measures. These include the two most popular measures for industry competition in the economic and strategy literature (i.e., HHI and industry profitability), supplemented by two additional measures (i.e., the new entry ratio and the ratio of firm number change).

4.2.1. HHI

Industry competition is usually measured by industry concentration and profitability. A popular industry concentration ratio, HHI, has been widely used in business studies [14,19,37] and in competition law, antitrust, and management fields [38] to measure industry competition. It is calculated as the sum of squares of the market shares of the 50 largest firms in an industry and ranges from near 0 (perfect competition) to 1.0 (monopoly). Change in industry competition, \(\Delta \text{HHI}_{2010}\), is the difference in HHIs from 1997 to 2010 (i.e., \(\text{HHI}_{2010} - \text{HHI}_{1997}\)). \(\Delta \text{HHI}_{2011}\) and \(\Delta \text{HHI}_{2006}\) measure the differences in HHIs from 1997 to 2011 and that from 1997 to 2006, respectively. A positive \(\Delta \text{HHI}_i\) indicates increased industry concentration and, thus, reduced industry competition over the years.

4.2.2. Industry profitability

Industry profitability is another important measure for industry competition [33]. Low competition yields high industry profitability. Following previous studies [1,30], we measure industry profitability by the industry profit-to-sales ratio. Change in industry profitability, \(\Delta \text{Profit}_{2010}\), is the differences in industry profitability from 1997 to 2010 (i.e., \(\text{Profit}_{2010} - \text{Profit}_{1997}\)). \(\Delta \text{Profit}_{2011}\) and \(\Delta \text{Profit}_{2006}\) measure the differences between 2011 and 1997 and that between
Table 2
Description of variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source</th>
<th>Expected relationship to ΔHHI, and ΔProfit</th>
<th>Expected relationship to Rentry, and RΔnumber,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in HHI (ΔHHI)</td>
<td>Change in HHI from 1997 to 2010 or 2011 (e.g., ΔHHI_{2010} = HHI_{2010} - HHI_{1997}); HHI is calculated as the sum of squares of the market shares of the 50 largest firms within the industry</td>
<td>COMPUSTAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in industry profitability (ΔProfit)</td>
<td>Change in industry profitability from 1997 to 2010 or 2011 (e.g., ΔProfit_{2010} = Profit_{2010} - Profit_{1997}); Profit is calculated as the ratio of total industry net income to total industry sales</td>
<td>COMPUSTAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New entry ratio (Rentry)</td>
<td>Ratio of number of new firms during the 1997–2010 period to industry firm number in 1997</td>
<td>COMPUSTAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio of firm number change (RΔnumber)</td>
<td>Ratio of firm number change during the 1997–2010 period to industry firm number in 1997</td>
<td>COMPUSTAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet</td>
<td>Firm average inlink counts of an industry</td>
<td>Yahoo</td>
<td>To be tested</td>
<td>To be tested</td>
</tr>
<tr>
<td>Initial HHI (HHI)</td>
<td>HHI of 1997</td>
<td>COMPUSTAT</td>
<td>Negative (−)</td>
<td>Positive (+)</td>
</tr>
<tr>
<td>Initial industry profitability (Profit)</td>
<td>Industry profitability of 1997</td>
<td>COMPUSTAT</td>
<td>Negative (−)</td>
<td>Positive (+)</td>
</tr>
<tr>
<td>Industry size (Size)</td>
<td>Industry total sales of 1997</td>
<td>COMPUSTAT</td>
<td>Negative (−)</td>
<td>Positive (+)</td>
</tr>
<tr>
<td>Industry growth (Growth)</td>
<td>Ratio of industry total sales of 2010 or 2011 to that of 1997</td>
<td>COMPUSTAT</td>
<td>Negative (−) for ΔHHI, Positive (+) for ΔProfit,</td>
<td></td>
</tr>
<tr>
<td>Advertising intensity (Ad)</td>
<td>Ratio of total advertising expenditure to total sales of an industry in 1997 (calculated with firms with reported positive advertising expenditures)</td>
<td>COMPUSTAT</td>
<td>Negative (−) for ΔHHI, No expectation for ΔProfit,</td>
<td></td>
</tr>
<tr>
<td>R&amp;D intensity (Rd)</td>
<td>Ratio of total R&amp;D expenditure to total sales of an industry in 1997 (calculated with firms with reported positive R&amp;D expenditures)</td>
<td>COMPUSTAT</td>
<td>Negative (−) for ΔHHI, No expectation for ΔProfit,</td>
<td></td>
</tr>
</tbody>
</table>

2006 and 1997, respectively. A positive ΔProfit indicates increased industry profitability and, thus, reduced industry competition over the years.

4.2.3. The new entry ratio and the ratio of firm number change

We also draw from Porter’s [33] framework and examine two additional measures—that is, the new entry ratio (Rentry) and the ratio of firm number change (RΔnumber)—to determine the change in industry competition. We calculate the new entry ratio as the ratio of the number of new entry firms over the years to the initial number of firms in an industry. For example, Rentry_{2010} is the ratio of the number of new firms entering an industry from 1997 to 2010 to the firm number in 1997. A high new entry ratio reflects low entry barriers and indicates an increase in industry competition.

Firm number is a simple and direct measure of industry rivalry. The ratio of firm number change captures the results from both the new entry and exit of firms in an industry. We calculate it as the ratio of firm number change during a period to the initial firm number. For example, RΔnumber_{2010} is the ratio of the firm number change from 1997 to 2010 to firm number in 1997. A positive RΔnumber indicates an increase of the firm number in an industry and, thus, increased industry rivalry over the years.

4.3. Measure of Internet use

No direct measure of the degree of Internet use in each industry exists, which is the main difficulty in this research. After examining various potential Internet measures and methods to quantify the measure, we employ a combined approach of using a quantitative measure with the support of independent expert assessments to verify the measure.

For the expert assessments, we provided an industry list to a panel of four experts, including three academics and one industry expert, all knowledgeable in e-commerce, and asked them to independently rank the level of Internet use of each industry in its respective industry sectors and to provide justifications. Then, we took an average rank and compared their justifications. It is generally easy to rank some industries, such as those in the retail and services sectors, but considerably difficulty to rank others, such as those in manufacturing.

As an objective quantitative measure, we collected firm inlink data through Yahoo in fall 2010. Inlinks, also known as backlinks, are links from other websites to a firm’s website. Inlinks are created by firms’ stakeholders, such as customers, business partners, and third parties, in recognition of the value of the website and to reference the website. Inlinks are a key measure for website visibility, accessibility, and communication [46]. They are direct online references that lead visitors to a website. Their numbers directly determine website rankings in search engine results. Thus, inlinks are critical for customers to find and access firm website and online information. Previous research has found that inlink counts outperform awareness and overall advertising spending in determining firms’ website traffic [16,47]. Inlinks are also considered an online word-of-mouth channel that creates long-term customer value [46]. Following previous research on inlink counts [43], we collected inlink count data using the query term “linkdomain:abc.com” to retrieve links that point to all pages of a firm’s domain, including inlinks to all subdomains of the firm (e.g., http://www.abc.com, http://products.abc.com).

We calculate and examine the average inlink count of industries and match the ranking of the industry average inlinks to the expert assessments of industry Internet use. We find that the average industry inlink counts match well with the expert assessments of industry Internet use (i.e., the average industry inlink counts reflect the degree of Internet use in the industry). The underlying logic is that when an industry employs the Internet more in
business, the firm websites of the industry become more valuable
to stakeholders, and in turn, more inlinks are created. For example,
an industry that popularizes e-commerce will have much higher
average firm inlink counts than an industry in which firms use the
website for information purposes only.

To demonstrate the validity of using the average industry inlink
counts as a measure of industry Internet use, we summarize the
inlink counts data of the 23 retail industries included in the analysis
(method reported in the “Data” section) in descending order in Table
3. A close examination reveals that it is appropriate to use this
measure as a proxy of the level of Internet use in industries in cross-
industry analysis. As the highest industry inlink count of 3,481,113
reflects, the Internet is widely used in the industry of Catalog and
Mail-Order Houses because most firms in this industry are now
online. At the other end, the level of Internet use in the industries of
Eating Places (SIC 5812), Grocery Stores (SIC 5411), and Auto Dealers
and Gasoline Stations (SIC 5500) is low, ranging from 14,338 to
29,928 average industry inlink counts. These industries primarily
employ the Internet to provide basic information to customers.
Convenience stores (SIC 5412) have the lowest industry inlink count
because location is the most important factor to customers.

The data from other industry sectors (e.g., manufacturing,
 wholesale, services) also show the appropriateness of using the
average industry inlink count as a proxy for the level of Internet use
in comparing industries. 1 The five manufacturing industries with
the highest average firm inlink counts are Electronic Computers
(SIC 3571; inlink count 10,718,300); Books: Publishing or Publi-
ishing and Printing (SIC 2731; 2,374,593); Newspapers: Publishing
or Publishing and Printing (SIC 2711; 1,615,060); Motor Vehicle
Parts and Accessories (SIC 3711; 146,988); and Photographic
Equipment and Supplies (SIC 3861; 146,530). These industries have
a high level of Internet use. The five manufacturing industries
with the lowest average firm inlink counts are Fabricated Structural
Metal Products (SIC 3440; inlink count 1203); Steel Works,
 Blast Furnaces and Rolling and Finishing Mills (SIC 3310;
1149); Railroad Equipment (SIC 3743; 1045); Industrial Trucks,
 Tractors, Trailers and Stackers (SIC 3537; 880); and Primary
Smelting and Refining of Nonferrous Metals (SIC 3330; 503).
These industries have a low level of Internet use. The average industry
inlink counts in the manufacturing industries are 123,117, and
those of the retail industries are 243,419, reflecting the greater
importance of the Internet to the retail industries than to the
manufacturing industries.

In addition to the industry average firm inlink counts, industry
average website traffic may serve as a proxy for the degree of
Internet use in an industry. However, website traffic data is not
used because of accuracy and availability issues; that is, traffic data
reported by traffic monitoring tools, such as Alexa and Quantcast,
are not accurate and are often missing for small and medium-sized
firms [12,13].

4.4. Control variables

Following previous studies [28] on factors that change industry
concentration, we include the control variables initial HHI (or
initial industry profitability when analyzing profitability change),
industry size, industry growth, industry advertising intensity and
R&D intensity in this analysis. We expect the relationships
between the control variables and change in HHI to be negative,
the relationships between the control variables, except industry
growth, advertising intensity and R&D intensity, and industry
profitability change to be negative, and the relationships between
the control variables and new entry ratio and the ratio of firm
number change to be positive. We expect the relationship between
industry growth and profitability to be positive; the relationships
between advertising intensity and profitability and between R&D
intensity and profitability are not clear. Table 2 summarizes the
regression variables.

4.5. Data

We searched the COMPSTAT North America database for
financial information of all U.S. firms in 1997, 2006, 2010, and
2011, and we retrieved 10,441, 8232, 7790, and 7877 firm data sets,
respectively. We deleted companies with no or zero total assets and
sales reported. We also deleted industries with fewer than three
firms because of the potential unrepresentative industry HHI and
other industry ratios. Then, we matched the 1997, 2006, 2010, and
2011 industry data, which formed a data set of 316 industries of
four-digit SIC codes. Four sectors that have the most industries are
manufacturing (149 industries), wholesale (22 industries), retail
(23 industries), and services (42 industries), which we examine for
sector heterogeneity in our additional analysis.

4.6. Model estimation

A requirement of regression analysis is that the data be normally
distributed. However, frequency distributions of five variables in the
study (i.e., Internet use, industry size, growth, advertising intensity
and R&D intensity) were skewed. Thus, we applied a logarithmic
transformation to these variables. The operating equations with the
transformed variables to test relationships between industry
competition measures and Internet use are as follows:

\[ \Delta HHI_i = \alpha + \alpha_1 \log Internet + \alpha_2 HHI + \alpha_3 \log Size + \alpha_4 \log Growth_t + \alpha_5 \log Ad + \alpha_6 \log Rd + \epsilon_i \]  

\[ \Delta Profit_i = \alpha + \alpha_1 \log Internet + \alpha_2 \log Profit + \alpha_3 \log Size + \alpha_4 \log Growth_t + \alpha_5 \log Ad + \alpha_6 \log Rd + \epsilon_i \]  

\[ Rentry_i = \alpha + \alpha_1 \log Internet + \alpha_2 HHI + \alpha_3 \log Size + \alpha_4 \log Growth_t + \alpha_5 \log Ad + \alpha_6 \log Rd + \epsilon_i \]  

\[ Rnumber_i = \alpha + \alpha_1 \log Internet + \alpha_2 HHI + \alpha_3 \log Size + \alpha_4 \log Growth_t + \alpha_5 \log Ad + \alpha_6 \log Rd + \epsilon_i \]  

where \( \Delta HHI_i \) is the change in HHI, \( \Delta Profit_i \) is the change in industry
profitability, \( Rentry_i \) is the new entry ratio, \( Rnumber_i \) is the ratio
of firm number change, Internet is the industry average firm inlink
counts, HHI is the initial level (i.e., 1997) of HHI, \( \log Profit \) is the initial
industry profitability, Size is the total industry sales in 1997,
\( \log Growth_t \) is the industry growth rate over the period of study, \( Ad \) is
the industry advertising intensity in 1997, and \( Rd \) is the industry
R&D intensity in 1997.

5. Results

Table 4 reports the means and standard deviations of the data
(based on the 1997–2010 period) in the entire set and the sectors of
manufacturing, wholesale, retail, and services. On average,
industries became less competitive during the 13-year period,
with 8% and 1% average increases in HHI and profitability,
respectively. The HHI increases for the manufacturing, wholesale,
retail, and services sectors are 10%, 12%, 5%, and 8%, respectively.
This trend corresponds to the industry concentration data revealed
by the U.S. census, which reports that four-firm concentration
Table 3
Average firm inlink counts of the retail industries.

<table>
<thead>
<tr>
<th>SIC</th>
<th>Name</th>
<th>Sample firms</th>
<th>Average firm inlink counts</th>
<th>Use of the Internet rank/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>5961</td>
<td>Catalog &amp; Mail-Order Houses</td>
<td>Amazon.com, drugstore.com, School Specialty</td>
<td>3,481,113</td>
<td>1 The traditional business model is readily adaptive to the Internet; many pure e-businesses exist</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 Firms adopt the click-and-mortar model</td>
</tr>
<tr>
<td>5940</td>
<td>Miscellaneous Shopping Goods Stores</td>
<td>Barnes &amp; Noble, Toys R Us, Staples</td>
<td>639,040</td>
<td>3 Firms adopt the click-and-mortar model</td>
</tr>
<tr>
<td>5734</td>
<td>Computer &amp; Computer Software Stores</td>
<td>Gamestop, Hartco</td>
<td>555,100</td>
<td>4 The Internet is an important tool for operational and communicational purposes. A wide range of product information is online</td>
</tr>
<tr>
<td>5700</td>
<td>Home Furniture, Furnishings &amp; Equipment Stores</td>
<td>Bed Bath &amp; Beyond, Pier 1 Imports, Cost Plus</td>
<td>158,763</td>
<td>5 The Internet is an important tool for operational and communicational purposes. A range of product information is online</td>
</tr>
<tr>
<td>5735</td>
<td>Record &amp; Prerecorded Tape Stores</td>
<td>Hastings Entertainment, Trans World</td>
<td>96,114</td>
<td>6 The Internet is an important tool for operational and communicational purposes. A range of product information is online</td>
</tr>
<tr>
<td>5331</td>
<td>Variety Stores</td>
<td>Family Dollar Stores, Target Corp, Walmart</td>
<td>95,542</td>
<td>7 The Internet is an important tool for operational and communicational purposes. A range of product information is online. Store experience is important</td>
</tr>
<tr>
<td>5311</td>
<td>Department Stores</td>
<td>Macy’s, Sears Canada, JCPenney</td>
<td>87,892</td>
<td>8 Although online operations are available, traditional stores have an important role in this industry</td>
</tr>
<tr>
<td>5531</td>
<td>Auto &amp; Home Supply Stores</td>
<td>Canadian Tire, AutoZone, Advanced Auto Parts</td>
<td>67,880</td>
<td>9 Although online operations are available, traditional stores have an important role in this industry</td>
</tr>
<tr>
<td>5912</td>
<td>Drug Stores and Proprietary Stores</td>
<td>Rite Aid, Shoppers Drug Mart, Walgreens</td>
<td>65,718</td>
<td>10 The Internet is an important tool for customer product research and comparison</td>
</tr>
<tr>
<td>5945</td>
<td>Hobby, Toy &amp; Game Shops</td>
<td>Build-A-Bear, Toys R Us</td>
<td>61,167</td>
<td>11 Many adopt the click-and-mortar model. Customers enjoy the traditional store experience</td>
</tr>
<tr>
<td>5990</td>
<td>Retail Stores, Not Elsewhere Classified</td>
<td>Brookstone, Petsmart, Ulta Salon Cosmetics &amp; Frag</td>
<td>39,847</td>
<td>12 Some companies adopt the click-and-mortar model, and others rely on traditional stores</td>
</tr>
<tr>
<td>5600</td>
<td>Apparel &amp; Accessory Stores</td>
<td>Children’s Place Retail Stores, Gordmans Stores, Lululemon Athletica</td>
<td>39,076</td>
<td>13 Some companies adopt a click-and-mortar model, and others rely on traditional stores</td>
</tr>
<tr>
<td>5661</td>
<td>Shoe Stores</td>
<td>Foot Locker, Footstar, Shoe Carnival</td>
<td>35,663</td>
<td>14 The Internet is used for product/store information. Due to variety of women’s clothing, online transactions are often limited to brand-loyal customers</td>
</tr>
<tr>
<td>5621</td>
<td>Women’s Clothing Stores</td>
<td>Ann Taylor Stores, Destination Maternity, Talbots</td>
<td>31,003</td>
<td>15 The Internet is used for business communication and service (e.g., booking)</td>
</tr>
<tr>
<td>5812</td>
<td>Eating Places</td>
<td>Buffalo Wild Wings, Red Robin Gourmet Burgers, Starbucks</td>
<td>29,928</td>
<td>16 The Internet is used for communication purposes only. Online transactions are limited to specific targets/usage. Traditional retail stores are important to customers</td>
</tr>
<tr>
<td>5411</td>
<td>Grocery Stores</td>
<td>Loblaw Companies, Safeway, Sobeys</td>
<td>25,141</td>
<td>17 Store experiences are important to customers. The Internet is used for communication and product research</td>
</tr>
<tr>
<td>5944</td>
<td>Jewelry Stores</td>
<td>Birks &amp; Mayors, Signet Jewelers, Tiffany &amp; Co</td>
<td>24,843</td>
<td>18 Store experiences are important to customers. The Internet is used for communication and product research</td>
</tr>
<tr>
<td>5712</td>
<td>Furniture Stores</td>
<td>Haverty Furniture, Leon’s Furniture, Brick Group</td>
<td>22,610</td>
<td>19 The Internet is used for communication and branding purposes</td>
</tr>
<tr>
<td>5400</td>
<td>Food Stores</td>
<td>Krispy Kreme Doughnuts, Vitamin Shop</td>
<td>19,500</td>
<td>20 The Internet is used for communication purposes only. Traditional retail stores are important to customers</td>
</tr>
<tr>
<td>5500</td>
<td>Auto Dealers &amp; Gasoline Stations</td>
<td>Carmax, Clean Energy Fuels Corp, ZAP</td>
<td>14,338</td>
<td>21 Limited use of the Internet. Traditional retail stores are important to customers</td>
</tr>
</tbody>
</table>
Table 3 (Continued)

<table>
<thead>
<tr>
<th>SIC</th>
<th>Name</th>
<th>Sample firms</th>
<th>Average firm inlink counts</th>
<th>Use of the Internet rank/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>5900</td>
<td>Miscellaneous Retail</td>
<td>Cash America International, Superior Plus, Xponential</td>
<td>2142</td>
<td>22 Limited use of the Internet. Traditional retail stores are important to customers</td>
</tr>
<tr>
<td>5412</td>
<td>Convenience Stores</td>
<td>Bowlin Travel Center, Alimentation Couche-Tard</td>
<td>780</td>
<td>23 Locations are the most important factor</td>
</tr>
</tbody>
</table>

Table 4


<table>
<thead>
<tr>
<th>M (SD)</th>
<th>All</th>
<th>Manufacturing sector</th>
<th>Wholesale sector</th>
<th>Retail sector</th>
<th>Services sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of two digit SIC codes</td>
<td>20–39</td>
<td>50–51</td>
<td>52–59</td>
<td>70–89</td>
<td></td>
</tr>
<tr>
<td>Industry number</td>
<td>316</td>
<td>149</td>
<td>22</td>
<td>23</td>
<td>42</td>
</tr>
<tr>
<td>ΔHHI2010</td>
<td>.08</td>
<td>.10</td>
<td>.12</td>
<td>.05</td>
<td>.08</td>
</tr>
<tr>
<td>ΔProfit2010</td>
<td>.01</td>
<td>.01</td>
<td>.00</td>
<td>.02</td>
<td>.04</td>
</tr>
<tr>
<td>Rentry2010</td>
<td>.30</td>
<td>.24</td>
<td>.36</td>
<td>.27</td>
<td>.29</td>
</tr>
<tr>
<td>RΔnumber2010</td>
<td>.41</td>
<td>.35</td>
<td>.50</td>
<td>.41</td>
<td>.25</td>
</tr>
<tr>
<td>Internet</td>
<td>136,580.02</td>
<td>123,117.32</td>
<td>6869.19</td>
<td>243,418.87</td>
<td>283,658.11</td>
</tr>
<tr>
<td>(772,353.63)</td>
<td>(832,685.88)</td>
<td>(11,257.91)</td>
<td>(724,394.17)</td>
<td>(1,271,165.70)</td>
<td></td>
</tr>
<tr>
<td>IHHI</td>
<td>.29</td>
<td>.33</td>
<td>.32</td>
<td>.25</td>
<td>.23</td>
</tr>
<tr>
<td>LgAd</td>
<td>.20</td>
<td>.21</td>
<td>.41</td>
<td>.19</td>
<td>.16</td>
</tr>
<tr>
<td>IProfit</td>
<td>.04</td>
<td>.04</td>
<td>.02</td>
<td>.02</td>
<td>.03</td>
</tr>
<tr>
<td>Size (in millions of dollars)</td>
<td>24,978.50</td>
<td>20,074.56</td>
<td>15,122.06</td>
<td>40,450.11</td>
<td>13,219.70</td>
</tr>
<tr>
<td>(53,344.73)</td>
<td>(50,942.66)</td>
<td>(16,600.36)</td>
<td>(59,644.34)</td>
<td>(22,327.22)</td>
<td></td>
</tr>
<tr>
<td>Growth2010</td>
<td>2.40</td>
<td>1.76</td>
<td>2.44</td>
<td>2.24</td>
<td>2.49</td>
</tr>
<tr>
<td>(3.83)</td>
<td>(1.96)</td>
<td>(2.69)</td>
<td>(1.15)</td>
<td>(1.74)</td>
<td></td>
</tr>
<tr>
<td>Ad</td>
<td>.04</td>
<td>.05</td>
<td>.01</td>
<td>.04</td>
<td>.04</td>
</tr>
<tr>
<td>RΔnumber2010</td>
<td>.06</td>
<td>.05</td>
<td>.01</td>
<td>.03</td>
<td>.04</td>
</tr>
<tr>
<td>RΔnumber2010</td>
<td>.07</td>
<td>.06</td>
<td>.04</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>RΔnumber2010</td>
<td>.23</td>
<td>.27</td>
<td>.07</td>
<td>.10</td>
<td>.05</td>
</tr>
</tbody>
</table>

5.1. Results of hypotheses testing

Table 5 reports the Pearson correlation coefficients of variables in the entire data set. Table 6 reports the regression results of Eqs. (2)–(5) for the 1997–2010 period, including variable coefficients, R-squared values, and maximum variance inflation factor (VIF) values. As the main table for our analysis results, Table 6 includes results of regressions with and without LgAd and LgRd. Because advertising and R&D expenditures are optional reporting items, advertising and R&D intensities are not available for some industries. Including LgAd and LgRd in the analysis significantly reduces the sample size (i.e., a reduction of 126 or 40% of industries from model 2 to model 1). To make use of the full sample and confirm analysis results, we repeat and report analysis of Eqs. (2)–(5) without LgAd and LgRd. When examining industry profitability (e.g., models 3 and 4), we exclude industries with calculated negative profitability in 1997 and 2010. Negative industry profitability is usually caused by special conditions, such as annual loss of a dominating firm in an industry in our sample, and violates the profit-driven assumption of businesses.

The regressions based on Eqs. (2)–(5) achieved a good fit, with adjusted R-squared values ranging from .05 for model 3 (ΔProfit2010 as DV) to .25 for model 2 (ΔHHI2010 as DV) and for model 8 (RΔnumber2010 as DV). The maximum VIFs ranged from 1.28 to 1.33, smaller than the cutoff value of 5.0 [24]. Therefore, multicollinearity is not a concern.

Table 5

Correlations (all industries).

<table>
<thead>
<tr>
<th></th>
<th>ΔHHI2010_</th>
<th>ΔProfit2010_</th>
<th>Rentry2010_</th>
<th>RΔnumber2010_</th>
<th>LgInternet_</th>
<th>IHHI_</th>
<th>IProfit_</th>
<th>LgSize_</th>
<th>LgGrowth2010_</th>
<th>LgAd_</th>
<th>LgRd_</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔHHI2010_</td>
<td>1</td>
<td>-.06_</td>
<td>.10_</td>
<td>-.34***</td>
<td>.08_</td>
<td>.91***</td>
<td></td>
<td>.04_</td>
<td>.04_</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔProfit2010_</td>
<td>-.06_</td>
<td>1</td>
<td>.10_</td>
<td>-.34***</td>
<td>.08_</td>
<td>.91***</td>
<td></td>
<td>.04_</td>
<td>.04_</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rentry2010_</td>
<td>-.34***</td>
<td>.10_</td>
<td>1</td>
<td>.10_</td>
<td>-.06_</td>
<td>.03_</td>
<td>.10_</td>
<td>.04_</td>
<td>.04_</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RΔnumber2010_</td>
<td>-.41**</td>
<td>-.19***</td>
<td>.10_</td>
<td>1</td>
<td>-.06_</td>
<td>.03_</td>
<td>.10_</td>
<td>.04_</td>
<td>.04_</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LgInternet_</td>
<td>-.05_</td>
<td>.16**</td>
<td>-.03</td>
<td>-.10**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IHHI_</td>
<td>-.45**</td>
<td>.04_</td>
<td>.21**</td>
<td>-.01</td>
<td>.04_</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IProfit_</td>
<td>-.02</td>
<td>-.19***</td>
<td>-.10</td>
<td>-.01</td>
<td>-.06_</td>
<td>.03_</td>
<td>.10_</td>
<td>.04_</td>
<td>.04_</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LgSize_</td>
<td>-.10</td>
<td>-.05</td>
<td>-.13</td>
<td>-.10</td>
<td>.35_</td>
<td>-.18_</td>
<td>.12**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LgGrowth2010_</td>
<td>-.14</td>
<td>.40_</td>
<td>.38**</td>
<td>.23</td>
<td>.06_</td>
<td>.01</td>
<td>-.17**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LgAd_</td>
<td>-.13</td>
<td>.11</td>
<td>.18</td>
<td>.19</td>
<td>.19_</td>
<td>.12_</td>
<td>.02</td>
<td>-.09</td>
<td>.06_</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LgRd_</td>
<td>-.10</td>
<td>-.00</td>
<td>.12</td>
<td>.03</td>
<td>.13_</td>
<td>-.07_</td>
<td>.09</td>
<td>-.05</td>
<td>.11_</td>
<td>.05</td>
<td>1</td>
</tr>
</tbody>
</table>

_ p < .10 (two-tailed).
** p < .05 (two-tailed).
*** p < .01 (two-tailed).
In all eight regressions reported in Table 6, the level of Internet use is an important factor related to industry competition change with consistently significant coefficient estimates. The associations of Internet use with the changes in HHI and industry profitability are positive—that is, the more an industry uses the Internet, the more concentrated and profitable the industry becomes, or the less competitive the industry is. The associations of Internet use with the new entry ratio and ratio of firm number change are negative—that is, the more an industry uses the Internet, the less new entry and number of firms the industry has, or the less competitive the industry is. The results with four measures of industry competition consistently suggest that the high level of Internet use is associated with reduced industry competition. This result contradicts the widely held belief that the Internet drives industry or market competition. Thus, H0 and H1 are rejected, and H2 receives support.

The regression results of the control variables meet our expectations. In the case of models 1 and 2, the initial level of HHI is negatively related to concentration change, indicating that leading firms in concentrated industries are likely to lose market share over time or to grow less rapidly than less concentrated industries [27,41]. Industry size is negatively related to HHI change, reflecting that the larger the absolute size of an industry, the lower are its entry barriers and, thus, the greater is its competition [4]. Industry growth is negatively related to HHI change, suggesting that fast-growing industries provide more entry opportunities to new firms and expansion opportunities to existing firms, which, in turn, lead to a more competitive environment. These results confirm economic theories and previous empirical results [28].

5.2. Additional analysis

5.2.1. Sensitivity analysis

We repeat analysis for the 1997–2006 and 1997–2011 periods and report results in Table 7. The results are consistent with those of the 1997–2010 period, shown in Table 6. The results from ΔHHI2011, ΔHHI2006, Rentry2011, RΔnumber2011, and RΔnumber2006 provide support for H2, indicating that the high level of Internet use is associated with reduced industry competition. The relationships between Internet use and three dependent variables, i.e., ΔProfit2011, ΔProfit2006, and Rentry2006, are insignificant but have the expected signs.

5.2.2. Exploratory study on sector heterogeneity

We examine four industry sectors for potential sector heterogeneity of the relationship between Internet use and industry competition change. The manufacturing sector includes industries with two-digit SIC codes from 20 to 39, the wholesale trade sector includes industries from 50 to 51, the retail trade sector includes industries from 52 to 59, and the services sector includes industries from 70 to 89. Table 4 reports the descriptive statistics of these sectors. We use four dummy variables for the four sectors, which take the value of 1 for industries of a sector and 0 otherwise. We add the interactions of the Internet variable and the sector dummy variables in Eqs. (2)–(5) and report the results from the 1997–2010 period in Table 8.

As Table 8 shows, two interaction terms in model 17 are significant and positive, and all interaction terms in models 19 and 20 are significant and negative, suggesting that (1) the negative relationship between Internet use and competition change is consistent across various sectors and (2) the effect size of Internet use to the change of industry competition differs across these sectors. The interaction terms in model 18 (profitability change as DV) are not significant. According to the

Table 7

<table>
<thead>
<tr>
<th>DV</th>
<th>ΔHHI2006</th>
<th>ΔProfit2006</th>
<th>Rentry2006</th>
<th>RΔnumber2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>(9)</td>
<td>(10)</td>
<td>(11)</td>
<td>(12)</td>
</tr>
<tr>
<td>LgInternet</td>
<td>.02</td>
<td>.01</td>
<td>.02</td>
<td>.04</td>
</tr>
<tr>
<td>HHI</td>
<td>−.38***</td>
<td>−.38**</td>
<td>−.04</td>
<td>−.04</td>
</tr>
<tr>
<td>ΔProfit</td>
<td>−.49**</td>
<td>−.49***</td>
<td>.15</td>
<td>.15</td>
</tr>
<tr>
<td>LgSize</td>
<td>−.06</td>
<td>−.06</td>
<td>.15</td>
<td>.15</td>
</tr>
<tr>
<td>LgGrowth2006</td>
<td>−.03</td>
<td>−.03</td>
<td>.10</td>
<td>.10</td>
</tr>
<tr>
<td>LgRd</td>
<td>−.01</td>
<td>−.01</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>N</td>
<td>190</td>
<td>190</td>
<td>190</td>
<td>190</td>
</tr>
<tr>
<td>Adj. R²</td>
<td>.16</td>
<td>.16</td>
<td>.20</td>
<td>.20</td>
</tr>
<tr>
<td>Maximum VIF</td>
<td>1.27</td>
<td>1.27</td>
<td>1.27</td>
<td>1.27</td>
</tr>
</tbody>
</table>

Note: Many firms do not report advertising or R&D expenditures because they are optional reporting items. Including LgAd and LgRd in the analysis significantly reduces the sample size, so we report results from regressions with and without LgAd and LgRd in this table.

*, p < .10.
**, p < .05.
***, p < .01.
structure–conduct–performance paradigm in industrial organization theories, profitability is a performance measure, whereas industry concentration is a more fundamental industry structure element. Therefore, the HHI can be more sensitive to competition change. In addition, the new entry ratio and ratio of firm number change (DV of models 19 and 20) directly measure within-industry rivalry. Thus, the results from three of four competition measures indicate a differential effect of Internet use on industry competition change across industry sectors.

Using coefficients to rank the economic importance of Internet use to competition change, we find that the effect is more important for wholesale and manufacturing sectors than for the retail and services sectors. For example, in model 17, the variable LgInternet has a significant coefficient of .03, and the interaction term LgInternet × Wholesale has a significant coefficient of .05. Therefore, the coefficient of LgInternet for the wholesale sector is .08 (.03 + .05). Applying the same mechanism, the coefficient of LgInternet for the manufacturing sector is .05 (.03 + .02), higher than that of the retail and services sectors. In models 19 and 20, the effect sizes of LgInternet for the manufacturing and wholesale sectors are larger than or equal to those of the retail and services sectors.

6. Discussion

This research examines an important question: Does the Internet change industry competition, and if so, in what direction? In contrast with previous research that addresses one aspect of competition (e.g., price competition), we examine the relationship between Internet use and change in overall industry competition as measured by HHI, industry profitability, the new entry ratio, and the ratio of firm number change. Our results consistently show that the Internet is associated with decreased industry competition. The results from the exploratory study on sector heterogeneity indicate that the effect of Internet use on industry competition is stronger in the manufacturing and wholesale sectors than in the retail and services sectors.

6.1. Theoretical implications

Our result is contrary to the widely held belief that the Internet increases industry competition. It is in line with Elberse’s [17] findings on the merchandise assortments in the online music and home-video sales industry but in a much broader sense and from the perspective of industry structure changes. Previous studies focusing on one aspect of competition ignore the structural changes of industries and fail to capture the overall competition changes. For example, many scholars [34] believe that the Internet lowers entry barriers and enables more competitors to enter the market. However, a large number of small competitors, who lack market power, may not necessarily indicate intensified competition. In addition, Porter’s analysis on Internet changes to industry forces summarizes a long list of factors. The early view on Porter’s framework often emphasizes several selected factors (e.g., entry barriers) and could misinterpret the multifaceted implications of the Internet to industry competition change (e.g., will enhanced communication eventually increase or decrease competition?). Therefore, it is important to examine the competition change using economic measures such as HHI and industry profitability.

How does the Internet cause decreased industry competition? Contrary to the popular perception that the Internet is a tool for everybody and provides a channel for small competitors, the Internet is actually a channel of high fixed costs and low marginal costs. Making the Internet work more effectively than competitors is a strategic challenge because of the resource and labor costs. According to the resource-based view [2,7,36,48,49], companies have different resources and capabilities of using the Internet. Larger companies often have more resources and are in a better position than smaller companies to use the Internet in business, and the network externality effects amplify the competitive advantages of large firms on the Internet. The Internet may lower entry barriers but simultaneously squeeze the market space of small competitors, for whom the question in the Internet age becomes whether to grow or die.

Our results support the view of the winner–take–all structure of the Internet economy. From the customer side, the broad, fast communication and easy replication create dynamics in which customers converge, instead of diverge, in tastes and buying habits; thus, popular products become disproportionately profitable [18]. From a business perspective, because of the Internet’s high fixed and low marginal cost structure and because competition is in one (virtual) market, it is optimal to act aggressively (e.g., through saturation advertising) [31]. Returns on investment become highly skewed. Prior empirical studies [21,22] have documented positive value generation from Internet marketing expenditures only for the largest spenders.

6.2. Policy implications

Our results have significant strategic implications. Because the Internet actually shifts industry structures in a different way than was previously speculated, firms need to rethink, re-examine and reevaluate their business strategic focus/direction and future development in terms of competitive advantages. For example, Porter [34] suggests that with the intensified competition of the Internet age, firms can no longer sustain operational effectiveness. Our finding that the Internet leads to increased industry concentration and profitability highlights the strategic implication that operational effectiveness remains an important competitive advantage and can become more important as firms increase their Internet use. Larger firms continue to build and enjoy high market power. Conversely, it is more difficult for small competitors to compete and survive.

6.3. Limitations and further research

To our knowledge, this is the first study to empirically test the relationship between Internet use and the industry competition change. Most prior research explores firm-level phenomena, and overall, little research has empirically examined the Internet effects at the industry level. Further research is necessary to confirm our results and investigate industry changes caused by the Internet.

Table 8
Exploratory study results for heterogeneity among industry sectors.

<table>
<thead>
<tr>
<th>DV</th>
<th>ΔHHI_{2010}</th>
<th>ΔProfit_{2010}</th>
<th>Rentry_{2010}</th>
<th>θ{2010}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>(17)</td>
<td>(18)</td>
<td>(19)</td>
<td>(20)</td>
</tr>
<tr>
<td>LgInternet</td>
<td>.03</td>
<td>.02</td>
<td>.01</td>
<td>.05</td>
</tr>
<tr>
<td>IHHI</td>
<td>-.47</td>
<td>.20</td>
<td>.35</td>
<td></td>
</tr>
<tr>
<td>lProfit</td>
<td>-.10</td>
<td>-.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LgSize</td>
<td>-.07</td>
<td>.03</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>LgGrowth_{2010}</td>
<td>-.04</td>
<td>.11</td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td>LgAd</td>
<td>-.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
</tr>
<tr>
<td>LgInternet × Manuf</td>
<td>.02</td>
<td>-.07</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>LgInternet × Wholesale</td>
<td>.05</td>
<td>-.09</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td>LgInternet × Retail</td>
<td>.00</td>
<td>-.06</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>LgInternet × Services</td>
<td>.00</td>
<td>-.05</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>190</td>
<td>190</td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>Adj. R²</td>
<td>.29</td>
<td>.23</td>
<td>.25</td>
<td></td>
</tr>
<tr>
<td>Maximum VIF</td>
<td>2.01</td>
<td>2.10</td>
<td>2.01</td>
<td>2.30</td>
</tr>
</tbody>
</table>

* p < .10
** p < .05
*** p < .01.
Our cross-sectional study unveils the results of industry change after more than a decade of Internet diffusion in business practice. However, it does not capture or provide information on industry competition dynamics. Although our results indicate that the Internet eventually leads to decreased competition, the competition might be fierce at the initial stage of Internet use with a large number of competitors coming into the market. After some time, big players emerge, and the market space of small competitors is squeezed. Investigating this competition dynamic may provide interesting insights into understanding the function of the Internet in changing the industry structure.²

Our exploratory study reveals that the relationship between Internet use and the industry competition change is stronger in the manufacturing and wholesale sectors than in the retail and services sectors. Compared with the retail and services sectors, which emphasize the strategic role of the Internet and use it intensively (see Table 4 for sector comparison), the manufacturing and wholesale sectors are relatively slow in adopting the Internet in business [35]. A possible explanation for our result is the ceiling effect²; i.e., as Internet use increases, the effect of Internet use on industry competition change diminishes, leading to the lower effect of the Internet in the retail and services sectors than in the manufacturing and wholesale sectors. To test the potential ceiling effect, we divide industries in our sample into two groups according to the level of Internet use, i.e., industries of the top 25% of Internet use in one group and the rest in the other group. The dummy variable DInternet takes the value of 1 for industries of the top 25% group and 0 otherwise. We add the interaction term LDInternet in Eqs. (2)–(5). The results show that the interaction term is insignificant. That is, the ceiling effect is not significant. Another possible explanation is that the overall strategic attention devoted to the Internet in the manufacturing and wholesale sectors may result in an unequal and unbalanced use of the Internet among firms. Firms that intensively make use of the Internet in these industries may gain more market power than those in more Internet-intensive industries such as retail and services. Further research is required to theoretically understand and empirically confirm the sector heterogeneity.

7. Conclusion

Although the popular view holds that the Internet increases industry competition, the winner-take-all theory suggests the opposite. The effect of the Internet on industry competition has been widely discussed, but no empirical evidence based on overall industry change is available. In contrast with previous research that focuses on one element of competition, such as price competition, we employ economic measures of competition, including HHI, industry profitability, the new entry ratio, and the ratio of firm number change. Our results consistently show that the Internet is associated with decreased industry competition. The results from the exploratory study further suggest the differential effect of Internet use on industry competition across various sectors. Our results contradict the popular view on the Internet’s effect on competition and call for additional discussion and the re-evaluation of firms’ competitive strategy in the Internet age.

References


² We thank the anonymous reviewer who points this out.
Fang Wang is an Associate Professor of Marketing in the School of Business & Economics at Wilfrid Laurier University, Canada. She holds a PhD in MIS and an MBA in Finance. Her research focuses on e-commerce, marketing strategy, and long-term firm productivity. Her work has appeared in Information & Management, Journal of Marketing, Journal of the Academy of Marketing Science, Journal of Consumer Marketing, Internet Research, among others.

Xiao-Ping (Steven) Zhang is a Professor of Electrical and Computer Engineering, a Professor of Finance, and the Founding Director of the Communication and Signal Processing Applications Laboratory, Ryerson University, Canada. He is the CEO and co-founder of EdoSearch, an Ontario based company offering a content-based search and analysis engine for financial data. He holds BS and PhD degrees in electronic engineering from Tsinghua University and an MBA in Finance, Economics and Entrepreneurship with Honors from the University of Chicago Booth School of Business. He holds several U.S. patents, and his research has appeared in leading scientific journals, including IEEE Transactions on Signal Processing; on Image Processing; on Information Forensics and Security; on Multimedia; and on Neural Networks. His recent work in financial information processing and marketing strategies has led to publications in business journals such as Journal of Marketing and Journal of the Academy of Marketing Science. Dr. Zhang is a registered Professional Engineer in Ontario, Canada, a Senior Member of IEEE, and a member of Association for Computing Machinery. He is an Associate Editor for IEEE Transactions on Signal Processing, IEEE Transactions on Multimedia, IEEE Signal Processing Letters and Journal of Multimedia.