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Is IT Really Becoming a Commodity?

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IS IT REALLY BECOMING A COMMODITY?
Les TIC sont-elles vraiment en train de devenir des marchandises?

Completed Research Paper

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Abstract

Academics and others have claimed that IT is becoming a commodity input, one that can no longer confer a competitive advantage. If IT is becoming a commodity, the role played by IT in most firms should be akin to that played by utilities. We conduct an event-study to determine whether IT is becoming a commodity. We use the volatility of a firm’s stock price to certain macroeconomic news (news about shrinking or expanding demand) to compare the stock price behavior of utility firms with that of IT firms. We find that although the IT industry as a whole is not becoming a commodity, there are some firms within the IT industry that are similar to a utility. In addition, we find that the view that IT can confer a competitive advantage (as perceived by financial markets) was stronger during the dotcom boom period than at other times in the study period (1980-2007).

Keywords: Information technology industry, utility industry, event study, stock price volatility, financial market evaluation, competitive advantage, macroeconomic news, IT value.

Résumé

En nous appuyant sur des fondements théoriques, nous utilisons des données financières pour déterminer la validité de l’affirmation de Nicholas Carr selon laquelle « Les TIC n’ont pas d’importance ». Nous utilisons les fluctuations du prix de l’action d’une entreprise en fonction des nouvelles macroéconomiques pour comparer les évolutions du prix de l’action des entreprises de biens utilitaires à celles des entreprises du secteur TIC. Nous en concluons que si le secteur TIC dans son ensemble n’est pas en train de devenir une marchandise, certaines entreprises peuvent être assimilées au secteur des biens utilitaires.

Introduction

The proportion of IT budgets spent acquiring IT products and services from external sources has steadily increased over the past three decades. A smaller proportion is being spent on internally produced products and internally provided services. Competing firms can acquire the same IT products and services from these external providers. This phenomenon has led academics and others to claim that IT is becoming a commodity input (Carr 2003; Thatcher and Pingry 2007), an input that is not qualitatively differentiated across competitors in an industry. IT is becoming more like a utility that everyone needs though it can no longer be a key to competitive advantage. If true,
there are dire consequences for IT academics and practitioners. Since IT hardware costs continue to drop more than 20 percent per year, no firms will be willing to make investments in new IT applications. Instead, firms will adopt a defensive strategy with their IT investments, making only those IT investments necessary to sustain their current IT applications. This will undoubtedly lead to the demise of many firms in the IT industry and possibly, the end of IT-related academic disciplines.

Nicholas Carr’s provocative article, “IT Doesn’t Matter” (2003), and book, “Does IT Matter? Information Technology and the Corrosion of Competitive Advantage” (2004) are based on the premise that IT has become a commodity and therefore, no longer is a source of competitive advantage. Numerous academics and practitioners have criticized Carr’s article (Brown and Hagel 2003; Varian 2003). However, we are not aware of any attempts to empirically test the assertion that IT is no longer a source of competitive advantage. Neither Carr, nor his critics (at least those who have had their rebuttals published) provide strong empirical evidence to support their arguments. Even Carr’s critics acknowledge that he makes some good points. Most disagree with his conclusions.

We will determine whether there is empirical evidence to support claims that IT is becoming a commodity. To our knowledge, this is the first attempt to directly examine data to determine whether there is evidence to support such a claim. In this paper we describe a study that uses financial market data to determine whether there is evidence to support Carr’s assertion that IT is becoming a utility. Our study is based upon the assertion that if IT has become a commodity, we should find that the volatility in market value of IT industry firms to economic news should be the same as that of firms in the utility industry to the same economic news. The rationale for this assertion is provided in the next section. The products and services offered by utility industry firms are commodities. If IT is gradually becoming a commodity, we should find that IT firms’ volatility to changes in economic conditions should be decreasing over time and approaching the volatility of utility industry firms.

We study the performance of firms in the IT and utility industries beginning in 1980 and ending in 2007. We chose 1980 as the starting point because the initial claims that firms can use IT to obtain a competitive advantage began appearing in the literature in the 1980s, e.g., Ives and Learmonth (1984). Our analysis of the data clearly shows that IT is not a commodity, nor is it becoming a commodity. The IT-engendered competitive advantage opportunities have not decreased over time. In addition, we find that the competitive advantage opportunities in the dotcom boom period (1995-2001) were greater than the opportunities available at other times. Finally, IT sector-based exploratory analysis suggests that IT sectors vary a great deal. Some sectors are very much like utilities, while others are dramatically different from utilities. Moreover, the strategic importance of the products or services offered by firms in a sector may change over time.

This paper is noteworthy for at least two reasons. As mentioned earlier, it is the first empirical study to determine whether IT is becoming a commodity, and consequently, less strategically relevant. Additionally, we develop a novel, financial market-based approach to determine whether IT is becoming a commodity. This approach could be used in other studies of interest to IS academics and to academics in other functional areas of business. In the next section we develop the theoretical bases for our work. We follow the theoretical development with a description of our empirical study and present our results. Finally, we discuss our results and conclusions, limitations of our study and potential directions for further research.

**Theoretical Bases**

For a resource to be the source of a competitive advantage, it must be scarce, such that competitors cannot easily acquire it. The term “commodity” implies that the product is produced by many different firms and is uniform in

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1. The *Harvard Business Review* published a number of letters to the editor that were written in response to Carr’s article in the June, 2003 issue (“Does IT Matter? An HBR Debate). The published letters included responses from a number of well known academics (Steven Alter, Warren F. McFarlan and Richard L. Nolan, Vijay Gurbaxani, and Vladimir Zwass) and practitioners (Paul Strassman, Marianne Broadbent, Mark McDonald, and Richard Hunter, Tom Pisello, and others). In addition, some of the best known IT industry executives responded in public to Carr’s article (e.g., Bill Gates and Steve Ballmer (Microsoft), Craig Barrett (Intel), Carly Fiorina (HP), and Brad Boston (Cisco)).

2. It should be noted that it is well known that the volatility of stock prices to new information differs across industries (Kaplan and Peterson 1998). The volatility of prices of firms in the utility industry is low compared to most other industries (Kaplan and Peterson 1998), because the demand for this industry’s products is relatively stable.

3. The term resource is used in a very general sense. At a very high level, it could refer to a firm. At a lower level, it could refer to a business process within the firm, or an input (i.e., asset acquired from an external source) to the firm.
quality across firms that sell it (e.g., oil, gas, corn, wheat, electricity, etc.). Most firms are extremely dependent on some commodities (e.g., electricity, transportation services), but few will argue that these commodities enable firms to obtain competitive advantages. The basis for the claim that IT no longer provides a competitive advantage is that with increased standardization, lower costs and increased outsourcing, IT is now easily available to all market participants. The core functions of IT – data storage, data processing and data transport – have become available and affordable to all. Since IT is no longer scarce, it now is a cost of doing business that all market participants must pay. These are the key arguments made by Carr to support his contention that IT can no longer be a source of competitive advantage.

There are many arguments against the above claims. It is not IT that confers a competitive advantage, but the innovations in business practices that IT enables that confer the advantage. In other words, IT is not the scarce resource. It is the ability to use IT to reengineer business practices that is scarce. Another argument goes as follows: competing firms are not identical; they differ in terms of their extant IT capabilities upon which new applications are deployed. These differences in existing IT capabilities across competing firms provide competing firms with different payoffs for the same new IT application. In other words, it is the cumulative effect (in a sense) of all IT usage within a firm that is scarce. Yet another argument is that as long as Moore’s Law holds, novel IT applications will enable some firms to gain advantages that competitors will not enjoy because firms differ on dimensions other than their IT capabilities. No two competitors have exactly the same business model. In this case the scarce resource is the business models that firms employ which are different across competing firms, so that the business practices together with a new IT application cannot be copied easily. Many other arguments may be made to counter claims that IT is no longer a source of competitive advantage. The best way to settle this debate is with empirical evidence. Here we present the theoretical bases that underlie our use of financial market data to determine whether IT is becoming a commodity.

**Economic Conditions and Industry Demand**

In any economy, economic conditions improve, stay the same, or worsen over time. The demand for products and services in the economy is affected by these economic conditions. In general, when economic conditions improve, demand for products and services increases, and when economic conditions worsen, demand for products and services decreases. However, the effect on demand resulting from changes in economic conditions is likely to be different across industries. Clearly, demand for some products is not as greatly affected by economic conditions as are others. For example, demand for drugs are affected less by changes in economic conditions than is demand for furniture. Consumption of medicines is unlikely to be greatly affected by economic conditions. Medicines are more of a “must buy” for most consumers than is furniture. The products from some industries are necessities, while others are discretionary for most consumers.

**Firm Investments and Demand Implications for Commodities and for IT**

For our purpose, firms make two types of investments.\(^4\) Type I investments are those necessary to sustain the firm’s current operations (i.e., investments necessary to provide the products and services to meet customer demand). Type II investments fund new initiatives that will enable the firm to perform better in the future. Type II investments may enable a firm to expand operations, change the way it will operate in the future, or even completely change the firm’s direction. Included among the investments that firms make are investments necessary to acquire commodity inputs, such as electricity. Some commodity inputs (e.g., electricity) are absolute necessities for firms. The demand for commodities is affected by the demand in the economy. When demand rises, Type I investments necessary to meet the increased demand will rise (and vice versa). Consequently, Type I investments made by firms will cause demand for commodities to rise or fall roughly in proportion to changes in demand in the economy. Type II investments typically include discretionary expenditures in assets that will enable the firm to perform better in the future (e.g., human capital, R&D, etc., as appropriate for a firm). Investments in commodities are unlikely to be a larger proportion of Type II investments than they are of Type I investments since they are not the key to improving a firm’s future performance. Commodities are unlikely to be the key to the creation of valuable, scarce resources. As a result, demand for commodities is likely to be relatively stable in the economy as a whole.

\(^4\) We use the term “investments” rather loosely, to refer to all types of disbursements made by firms.
Consider IT investments made by firms. Type I IT investments are those necessary to sustain the applications currently in use (sustaining investments). Sustaining investments (Type I) are necessary to enable firms to continue to perform their current operations while executing their current business model. These are investments necessary to keep the firm running as it currently does. So, for example, if sales increase, firms may have to invest in IT to handle increases in transaction volume. If a new IT security threat is discovered, firms will have to invest in products and services to protect against this threat. These are Type I investments. In effect, if a firm fails to make these investments, IT may not be able to provide adequate operational support, adversely affecting the firm’s cash flows. Thus, firms may have to invest in maintenance of applications currently in use, provide support for users of these applications, make new investments to keep current systems secure, etc. Type II investments, on the other hand, are investments in new applications that a firm plans to deploy in the future (new application investments). New application investments may help firms improve productivity, product quality, or customer value, introduce new products or services, etc. in the future. These investments frequently enable firms to change their business models.

In so doing, firms are likely to be better off (in the future) than they would be without these new application investments. New application investments may also involve enhancing a current IT application, if such an enhancement will enable a firm to improve productivity, improve product quality, increase customer value, or introduce new products or services. New application (Type II) investments are, in effect, investments that will confer an advantage for the firm in the future.

If IT has become a commodity, firms will still need to make Type I investments. However, firms will no longer invest in new IT applications that could enable them to perform better in the future. This is particularly true for IT investments because IT costs continue to decrease rapidly and competitors, by acquiring the same technology at a lower cost at a later date, can eliminate first mover advantages very quickly. As a result, no firm will be willing to be the first in its industry to implement a new IT application. Firms will only make sustaining IT investments. In other words, the demand for IT industry firms should fluctuate in a manner similar to that of commodity industry firms. When demand in the economy increases, the demand for IT industry firms should increase proportionately as firms invest in IT to sustain their operations. However, if IT has not become a commodity, the IT investments firms make will include investments in new IT applications that go beyond simply scaling their IT investments to match changes in demand.

**Prioritizing IT Investments**

There is evidence that firms make Type I investments before they make Type II investments. Given a budget, firms will first fund activities necessary to sustain their current operations and then fund activities that will change the way they will operate in the future. In other words, firms first invest in assets that enable them to maintain cash flows from current operations. In the 1980s, a commonly voiced complaint by IT executives was that maintenance costs were consuming IT budgets, leaving few funds for new IT applications (Davis and Applegate 1995). The situation is epitomized by the following statement (Ewers and Vessey 1981), “Information Systems (IS) is facing a dilemma: software is absorbing an ever-increasing proportion of the total IS budget while maintenance is absorbing an ever-increasing proportion of the software budget, in the not too distant future, unless this trend is arrested, or reversed, nearly all software resources may be required for maintenance.”. Christianson (2000) relates a (sarcastic) question that was posed to him by Andy Grove (CEO of Intel™ at the time) when Christianson’s presentation to Intel’s senior executives suggested that they should invest in inferior technologies that, at the time, would not contribute to profits. Andy Grove asked: “Should we stop funding our current products that are very profitable and fund products that none of our customers want that will lose money” (because, down the road such investments could be profitable)? In general, regardless of the type of investment (not just IT), firms fund activities necessary to keep their current operations running smoothly before they fund new initiatives. In other words, firms will first fund activities necessary to maintain current cash flows before funding activities that will develop assets that could affect future cash flows.

For IT spending by firms, this implies that firms will first make investments necessary to keep their current IT applications running smoothly and only fund new applications from remaining funds. The fact that firms first make sustaining IT investments before they invest in new IT applications is a key assumption in this work.

When economic conditions are good, firms have more money to spend (and vice versa). Since investments in new IT applications are made after sustaining investments, when economic conditions improve, investments in new IT applications will increase. Essentially, customers have more money to spend on IT and these expenditures will fund new IT applications. When economic conditions worsen, the investments in new IT applications will decrease.
Investments to sustain current IT applications will not be as greatly affected by economic conditions. Firms make sustaining investments in good and bad economic times. Specifically, investments in software, hardware, security, user-support, etc. aimed at keeping current applications functioning as they should, will be made in good and bad times. More investments necessary for new IT applications will be made when economic conditions are good (and vice versa).

Financial Market Evaluation

It is a well-established paradigm in finance that asset prices in financial markets are affected by the arrival of new information. The reaction of various types of financial markets to new information has been widely studied in the finance literature. For example, studies have investigated the “new information” effect on stocks, bonds, futures contracts, foreign-exchange rates, interest rate and currency options, etc. (Nofsinger and Prucyk 2003). This paradigm has been the basis for a number of event studies of the effects of IT decisions by firms on a firm’s stock price, e.g., (Agrawal et al. 2006; Brown et al. 1995; Chatterjee et al. 2001; Dehning et al. 2003; Dos Santos et al. 1993; Im et al. 2001; Ranganathan and Brown 2006; Subramani and Walden 2001).

The most widely accepted model linking stock prices to information posits that stock price values are determined by the discounted value of expected future dividends (Hardouvelis 1987). This model can be stated as:

\[
P_t = E \left[ \sum_{r=1}^{\infty} \frac{D_{t+r}}{(1+r_{t+r})} \mid \Omega \right]
\]

(1)

Where \( P_t \) is the price of the stock at time \( t \), \( E[\cdot \mid \Omega] \) is the expectation conditional on information available at time \( t \) (i.e., \( \Omega_t \)). \( D_{t+r} \) is the dividend paid at time \( t+r \), and \( r_{t+r} \) is the risk-adjusted discount factor for cash flows that occur at time \( t+r \). Thus, unexpected changes in economic conditions that affect consumer demand can be expected to affect the stock prices of firms. For a firm whose product demand is relatively insensitive to economic conditions, the impact of demand-related macroeconomic information will not affect its stock price as much as it would affect a firm whose product demand is greatly affected by economic conditions.

We are interested in the financial markets’ evaluation of assets in the presence of new information. However, this event study is distinct from earlier studies in two ways. First, we are concerned with new information in the form of macroeconomic news that signals a change in demand in the economy, for example, the consumer confidence index. In the US, new macroeconomic information is made available to investors on a periodic basis by US government agencies and other non-profit agencies. Second, unlike earlier studies involving IT-related, financially relevant events, we are not concerned about firm-level IT decisions. Thus, the usual, firm-specific events (e.g., earnings announcement, new product development etc.) are not relevant. Specifically, our interest is in the financial market’s evaluation of groups of firms (industries or industry sectors) in the presence of new macroeconomic information. For the purpose of this study, we examine two industries: IT and utilities. We use the utility industry as a representative commodity input used by firms for two reasons. First, most firms use the products of this industry, just as most firms use IT industry products and services to operate. Both are infrastructural technologies. Second, Carr (2003) supports his case by comparing the demand for electricity and railroads over time (from their inception) to the demand for IT, claiming that the demand of IT over time mimics the demand for electricity and railroads. He suggests that IT has reached the same stage as electricity did, before electricity no longer provided opportunities for firms to gain strategic advantages. Our primary focus is on the entire IT industry because we want to determine whether the industry as a whole, is becoming a commodity.

US government agencies and other nonprofit agencies provide macroeconomic information in the form of formal news releases. These macroeconomic news releases provide a variety of different information that is indicative of the state of the economy. There has been a great deal of interest in financial markets’ reactions to macroeconomic news in the finance literature, e.g., (Chatrath et al. 2006; Hardouvelis 1987; Jones et al. 1998). Stock prices rise when new information indicates that the economy is doing better than the financial markets expected (i.e., the economic conditions are better than expected). Stock prices fall when new information indicates that the economy is doing worse than the market expected (Hardouvelis 1987). The stock price change depends on the magnitude of the change in economic conditions (vis-à-vis expectations) and the nature of the underlying asset (i.e., the firm). Firms whose performance is greatly affected by a change in economic conditions will have their stock prices change more than firms whose performance is less affected by such change. In other words, when economic conditions change, the stock prices of some firms are affected more than other firms.
The stock price of a firm whose products are primarily used by other firms to sustain their current operations will not be greatly affected by a change in economic conditions. Customers must buy the firm’s products to sustain their current operations and sustaining investments are made before investments in new applications. Therefore, the demand for the firm’s products will be relatively stable; the stock price will not be greatly affected. On the other hand, the stock price of a firm whose products are the key to other firms’ development of new products and services will be greatly affected by changes in economic conditions. In our context, this suggests that if firms only make sustaining IT investments, the demand for IT products and services will not be greatly affected by changes in economic conditions. However, if firms continue to invest in new IT applications, the demand for IT products and services will be greatly affected by changes in economic conditions. In the latter case, when economic conditions deteriorate, firms will not spend as much on new IT investments (and vice versa). As a result, demand for the products and services of IT industry firms will be more greatly affected by changes in economic conditions if firms continue to invest in new IT applications. Thus, if Carr is right, we should find that the stock price reaction of IT industry firms to changing economic conditions should be similar to that of utility industry firms.

As noted earlier, it is widely known that the volatility of stock prices to new information differs across industries (Kaplan and Peterson 1998). The volatility of prices of industries whose products are deemed necessities (e.g., food, freight, utilities) is lower than industries whose products are deemed discretionary (e.g., building materials, amusement, engineering services) (Kaplan and Peterson 1998). The volatility of prices of firms in the utility industry is low compared to most other industries (Kaplan and Peterson 1998), because the demand for this industry’s products is not as greatly affected by economic conditions, as is the demand for products and services for firms in most other industries. The products of firms in the utility industry can no longer be a basis for competitive advantage; these products are widely available to all competitors. As a result, the demand for the product of a firm in the utility industry is relatively stable. Thus, if IT is becoming less strategically relevant (i.e., it is becoming a commodity), the volatility of stock prices of IT industry firms to changes in economic conditions should be decreasing over time and approaching that of utility industry firms to the same change in economic conditions. This leads us to our main hypothesis. To determine if IT has steadily (at least since 1980) become more of a commodity, we hypothesize that:

\[ H1: \text{The volatility of stock prices of firms in the IT industry to changes in economic conditions has decreased over time and is approaching the volatility of stock prices of firms in the utility industry.} \]

It is important to note that we are not concerned about the actual state of the economy at any point in time (e.g., whether it is in an up or down business cycle). We are only interested in the change in economic conditions as signaled by new news that reaches financial markets. Moreover, we are also not concerned about the magnitude of the change in the state of the economy. This is because we are only interested in the comparative changes in stock prices of firms in the IT and utility industries. Consequently, the actual content of the news or its impact on individual firms is not pertinent. We should also note that we do not need to know why a firm (industry) reacts to specific news positively or negatively.

The opening of the Internet to commercial use, the development of hypertext protocol at the European Laboratory for Particle Physics (popularly known as CERN) in 1991, (which became the World Wide Web in 1991) and the release of Mosaic™ in 1993 ushered in a period in financial markets that has come to be known as the dotcom boom period. This period lasted until 2001. The dotcom boom period began in the mid-nineties with the entry of new firms that sought to leverage the Internet, and, in many instances, competed with existing firms in many industries. During this period, it was widely perceived that there were tremendous opportunities for novel IT applications; applications that could have a great impact on the future prospects for firms in many industries. We know of no other period in the short history of IT where there was anywhere near as widely-held perceptions of the potential impact of new IT applications. Consequently, during the dotcom period, it is likely that firms planned larger investments in new IT applications than at any other period in IT history. If firms invest in new IT applications when economic conditions are good and scale back their investments in new applications when times are bad, we should find the volatility of stock prices of IT industry firms during the dotcom boom (to changes in economic conditions) period to be higher than it was in other periods. Thus, we hypothesize that:

\[ H2: \text{The volatility of stock prices of firms in the IT industry was the same during the dotcom period as it was in non-dotcom periods.} \]

In addition to the formal hypotheses stated above, we also sought to explore differences across IT industry sectors. The IT industry is comprised of many different types of firms grouped by sectors. For example, these sectors include firms that manufacture hardware components (e.g., Intel, Logitech & iomega), assemble and sell computers (e.g.,
Dell, HP & Gateway), produce software (e.g. Microsoft, Oracle & SAP), manage computing facilities for firms (e.g. EDS, BRC & OAO), provide custom programming services (e.g., Infosys, Intellicorp & Keane), and so on. An intriguing question is whether some IT sectors are being commoditized, while others are more critical to the new IT applications being developed. Moreover, a sector could be critical to new application development at one point in time and later become more of a utility. It is difficult to state specific hypotheses without being able to identify points in time when such shifts should occur. Thus, we undertook this portion of our study with an exploratory mindset, intending to examine the data closely, without intending to test formal hypotheses.

In the next section we describe the study that was conducted to test the two hypotheses and explore sector differences.

Empirical Study - The Data

The US government and independent agencies release a variety of monetary and non-monetary information that are pertinent to a financial market’s evaluation of firms (e.g., the unemployment rate, personal income, consumer price index, durable goods orders, producer price index, construction spending, gross national product, etc.). We considered macroeconomic announcements that primarily affect demand in the economy and are commonly considered in the finance literature (Chatrath et al. 2006; Ederington and Lee 1993; Hardouvelis 1987; Jones et al. 1998). We did not consider announcements that are directly related to interest rates. Note that a component of the denominator in Equation (1) is the risk-free rate, which is affected by interest rate announcements (e.g., federal funds rate changes). We then selected those announcements for which we were able to obtain precise information on the dates and times when the news was released, going back to 1980, whenever possible. Thus, we have announcement information for the period from 1980 to 2007. The events in this study are these macroeconomic news announcements. We obtained data on eleven different types of announcements in all. Summary information on the announcements for the news events used in this study are presented in Table 1. Note that there may be more than one event on the same day. In total, the 3357 raw events occurred on 2679 distinct trading (event) days. It is not possible to separate the market reaction by event for those days on which there were multiple events. However, since we are not interested in the impact of different types of events, this did not present a problem. For aggregation convenience, when more than one event occurred on the same day, we randomly assigned the date to one of the events that occurred on that date.

In event studies it is extremely important to know when news reaches financial markets, because in an efficient market, the price response to new information is immediate. In many instances, researchers cannot be certain when the news reached the market because the date cannot be determined from the news source. For example, when the source of the news is a daily periodical, one cannot be sure whether the news reached the market on the day prior to the periodical’s print date (i.e., it was released during the prior trading day) or on the print date (it was released the day before, but after the markets closed). Hence, many event studies consider changes in market prices using a two-day event interval, including the day prior to the print date and the print date itself.

Most macroeconomic information is released by government and nonprofit organizations on a regular schedule. Some macroeconomic news is released monthly, some bi-monthly, some quarterly etc. These regularly scheduled macroeconomic news releases typically take place on specific days and at specific times of day. Most of these announcements are made just before US financial markets open. A few announcements are made during the trading day (e.g. federal interest rate decisions). We know of no regularly-scheduled macroeconomic news releases that are made after US financial markets close. Assuming the semi-strong form of the efficient markets model, for which empirical evidence is strong, market prices fully reflect publicly available information (Fama 1991). As a result, the effect of these macroeconomic announcements on stock prices is observed on the day the information is released. Thus, we expect the news to affect stock prices on the day that the news is released.

In order to identify firms in the IT and utility industries, we compared the conventional four-digit SIC classification with the more recently developed six-digit NAICS classification system. SIC codes have not been updated since

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5 One could argue that all these macroeconomic news events affect dividends and interest rates, since in the long run, increases in demand will lead to an increase in interest rates (to avoid an increase in inflation). However, some of the news in these events has an immediate effect on demand (e.g., a change in consumer spending). Note that firm and industry betas (i.e., a measure of a firm or industry's volatility, or systematic risk, in comparison to the market as a whole) are not appropriate for our purpose because we are interested in volatility of prices to new macroeconomic news, and not other news that could affect an industry (e.g., news that has a significant impact on key inputs to the industry).
1987 while the NAICS codes were most recently refined in 2007. The SIC classification is particularly problematic for IT industry firms because new technologies enable new IT products and services, possibly requiring the creation of new categories to more accurately categorize firms. After careful scrutiny of the IT sectors under the two coding systems, we concluded that the NAICS codes offer a finer classification of IT firms, enabling a more accurate classification of IT firms.\(^6\) The utility sectors are not very different in the two classification systems. At the six-digit NAICS level, eight utility sectors and twenty-five IT sectors appeared in our data. The first three columns in Table 3 (Table appears later) provides sector-related details. We obtained daily stock price data for all firms in these sectors from the CRSP database and matched the NAICS codes to individual firms via the Compustat database. The CRSP database only includes SIC codes, while the Compustat database contains both SIC and NAICS codes.

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Number of Events</th>
<th>Frequency</th>
<th>Start Date</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Confidence Index</td>
<td>338</td>
<td>Monthly</td>
<td>1/29/1980</td>
<td>The Conference Board</td>
</tr>
<tr>
<td>Gross Domestic Product</td>
<td>360</td>
<td>Monthly</td>
<td>1/18/1980</td>
<td>Dept. of Commerce: Bureau of Economic Analysis</td>
</tr>
<tr>
<td>New Residential Construction (Housing Starts)</td>
<td>438</td>
<td>Monthly</td>
<td>1/17/1980</td>
<td>Dept. of Commerce: Census Bureau</td>
</tr>
<tr>
<td>Manufacturer's Shipments, Inventories, and Orders Survey</td>
<td>440</td>
<td>Half Month</td>
<td>2/27/1990</td>
<td>Dept. of Commerce: Census Bureau</td>
</tr>
<tr>
<td>Michigan's Consumer survey (CSI)</td>
<td>116</td>
<td>Monthly</td>
<td>7/31/1998</td>
<td>Survey Research Center at the University of Michigan</td>
</tr>
<tr>
<td>Manufacturing and Trade Inventories and Sales</td>
<td>136</td>
<td>Monthly</td>
<td>11/15/1996</td>
<td>Dept. of Commerce: Census Bureau</td>
</tr>
<tr>
<td>Personal Income</td>
<td>346</td>
<td>Monthly</td>
<td>1/17/1980</td>
<td>Dept. of Commerce: Bureau of Economic Analysis</td>
</tr>
<tr>
<td>Retail Sales</td>
<td>352</td>
<td>Monthly</td>
<td>1/11/1980</td>
<td>Dept. of Commerce: Census Bureau</td>
</tr>
</tbody>
</table>

For each announcement, we computed a market-weighted price change for the announcement for each group (industry or sector, as applicable) on the announcement day. We computed the price volatility for group \(j\) on day \(t\) \((R_{jt})\) as follows,

\[
R_{jt} = \frac{\sum_{i}(|P_{yt} - P_{yt-1}| \times N_{yt-1})}{\sum_{i}P_{yt-1} \times N_{yt-1}}
\]

where the price of the stock of company \(i\) in group \(j\) at the end of trading day \(t\) is denoted by \(P_{yt}\), \(N_{yt}\) is the number of shares outstanding for firm \(i\), in group \(j\), at the end of trading day \(t\), and \(R_{jt}\) is the market-weighted price change for the group of firms on day \(t\). We compute the absolute value because we are interested in the magnitude of volatility, not in the direction. Note that the return is determined by the “new news” in the announcement. For example, if the market expects consumer spending to increase by 1 percent, an announcement that consumer spending increased by 0.8 percent is likely to result in a negative return and an announcement that consumer spending increased by 1.2 percent is likely to result in a positive return. Note also that bad news may have a negative

\(^6\) Note that our main results (hypothesis tests) are unchanged when the SIC classification is used. The NAICS enables a better delineation when examining differences across sectors.
price effect, and that is just as important as good news having a positive price effect. Moreover, we are interested in
the relative price effect for IT industry firms to utility industry firms, i.e., the relative price effect to this news, for
two groups of firms. The relative price effect for the two industries enables us to test our hypotheses without
concern for the content of the “new news.” If IT is becoming a utility, the relative price effects should be decreasing
over time. Indeed, if IT is a utility, there should be no difference in the relative price effects to macroeconomic news
for IT industry firms and utility industry firms.

Analysis & Results

The “new” information in each of these announcements differs across announcements. The new information in some
announcements may signal a large change in economic conditions relative to other announcements. Thus, the
markets’ reaction to these announcements will differ across announcements. As noted earlier, however, these
differences are not important since we are interested in the relative price volatility for IT industry firms to utility
industry firms. We computed the ratio of the response (i.e., price change) to new information for IT industry firms
to utility industry firms. This ratio is an indicator of the relative effects of new macroeconomic news for firms in these
two industries. We also computed the price volatility of S&P500 firms as a benchmark and look at the ratio of IT to
S&P500 and Utility to S&P500 over time. We present these results in the two graphs in Figure 1.

In the left panel in Figure 1 we show the volatility to economic news for the IT industry, the utility industry and the
S&P500. We show the S&P500 volatility in the same graph as an indicator of overall market volatility to the same
news. In the right panel, we plot volatility ratios: IT/utility, IT/S&P500, and utility/S&P500. The price volatility for
IT industry firms to the news events range from 1.2 percent to 4.0 percent over the study period. IT industry volatility
has consistently been above market volatility, while utility industry volatility has mostly been below market volatility. From the left panel, it is easy to see that the volatility of IT industry firms was abnormally high between 1995 and 2002, reaching a peak in 2000. This period roughly corresponds to the dotcom boom period. From the right panel it is easy to see that the IT-utility ratio was above 1 for the entire period from 1980 to 2007; and IT-S&P500 ratio was above 1 except for the year 1980, while the utility-S&P500 ratio was mostly below 1.

![Figure 1: Price Volatility over Time](image)

*(The left panel compares the price volatility of the IT industry, utility industry and the benchmark S&P 500; the right panel shows ratios of the IT volatility, utility volatility and S&P 500 volatility)*

Hypotheses 1

Our initial analysis focuses on whether there is a significant difference between the volatility of IT industry firms
and utility industry firms. To test this hypothesis, we first estimate the following model:

$$Volatility_{ijt} = \beta_0 + \beta_1 \times Industry_i + \beta_2 \times Event_j + \beta_3 \times Year_t + \epsilon$$  \hspace{1cm} (3)

where $Volatility_{ijt}$ is the volatility of industry $i$, to event $j$ in year $t$. We group the NAICS codes into two industry
groups: 1 for the IT industry and 0 for the utility industry. Equation (3) specifies a simple fixed-effects model. The
estimation results are reported in Table 2, under “Model 1.” Due to space and display size limitations, and our
research interests, we have omitted the fixed-effects coefficients for the variable year (27 coefficients) and event (10
coefficients). The $Industry$ coefficient in Model 1 indicates that the IT industry has significantly higher volatility
than the utility industry. On average, IT industry volatility is 1.4 percent higher. This suggests that over the period from 1980-2007, the IT industry was very different than the Utility industry.

Hypothesis 1 asserts that the IT industry’s volatility is trending down over time as IT becomes more of a utility. To test this hypothesis, we re-coded years as follows: 0 for 1980, 1 for 1981, 2 for 1982, etc. We then treated the year as a continuous variable. We also added an interaction term between Industry and Year and estimated the following model:

\[
Volatility_{ijt} = \beta_0 + \beta_1 \times Industry_i + \beta_2 \times Event_j + \beta_3 \times Year_t + \beta_4 \times Industry_i \times Year_t + \epsilon
\] (4)

Estimation of the model in Equation (4) is reported in Table 2, under “Model 2.1.” Variable year has a significant positive effect (with a coefficient value of 0.015 and p-value less than 0.001), indicating that over time, volatility has increased (even after factoring in the interaction term). The interaction term is not significant, suggesting that the trend over time is the same for both IT and utility industries. We should note that R-square in financial studies of the market response to macroeconomic news is very low compared to the R-square reported in many empirical studies in IS. The R-square can be less than 0.01 and seldom exceeds 0.10, as many of these studies, like ours, include large, heterogeneous samples (Ederington and Lee 1993; Gerlach 2007; Tanner 1997).

The model in Equation (4) implies a linear trend over time while the graphs in Figure 1 clearly suggest a nonlinear year effect. To address this problem, we added a quadratic term \( year^2 \) to the model in Equation (4) to capture the non-linear year time effect. The results from estimation of this modified model are presented in Table 2, under “Model 2.2.” Adding a quadratic term for the year variable improved R-square from 0.048 to 0.065. The new term \( year^2 \) has a negative coefficient -0.00007 with a p-value less than 0.001. The industry coefficient (\( \beta_1 \)) continues to be positive and significant (after factoring in interactions) indicating that the volatility of prices of IT firms to changes in economic conditions is greater than that for utility firms. Hypothesis 1 is not supported. There is no evidence that IT is becoming more of a commodity; IT is not losing its strategic relevance.

| Table 2: Hypotheses testing Results (coefficients with t-values in parentheses) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Variables | Model 1 | Model 2.1 | Model 2.2 | Model 3 |
| Intercept | 0.004 (6.15*** | 0.008 (14.95*** | -0.0004 (-0.65) | 0.006 (8.82*** |
| Industry | 0.014 (53.89*** | 0.015 (27.56*** | 0.014 (26.3*** | 0.013 (38.7*** |
| Year | Omitted | 0.0002 (6.10*** | 0.002 (34.3*** | Omitted |
| Year^2 | - | -0.0004 (-1.24) | -0.000 (-0.28) | - |
| Industry*Year | - | - | - | 0.012 (14.9*** |
| Dotcom | - | - | - | 0.008 (14.5*** |
| Industry*Dotcom | Omitted | Omitted | Omitted | Omitted |
| Event | Omitted | Omitted | Omitted | Omitted |
| R-square | 0.100 | 0.048 | 0.065 | 0.102 |
| F-Value | 204.17 *** | 270.18 *** | 346.75 *** | 204.93 *** |
| df | 38 | 13 | 14 | 39 |
| N | 70251 | 70251 | 70251 | 70251 |

(*p-value<0.05; ** p-value<0.01 and *** p-value<0.001.)

**Hypotheses 2**

Hypothesis 2 states that the dotcom period is the same as the other periods for IT firms. We added a dummy variable dotcom which takes the value 1 for the period from 1995-2001 and 0 otherwise. We are primarily interested in determining whether the dotcom period has a different effect on the IT industry as compared to the utility industry than it did in other periods. We also added an interaction term Industry*Dotcom, and estimated the model specified in Equation (5).
In equation (5) the year variable is treated as a fixed effect in the same manner as Model 1. This specification loses one degree of freedom because of the overlap of our dummy variable dotcom with year. The results are reported in the column “Model 3” in Table 2. The dotcom period does have a significant and positive effect on firms’ volatility (with a coefficient 0.012 and p-value less than 0.001). The interaction term is also significant and positive, suggesting that IT firms are affected more than utility firms. Thus, hypothesis 2 is not supported. There were more opportunities for firms to use IT for competitive advantage during the dotcom period than any other period covered by our study. The total effect of dotcom on the IT industry is 0.020, i.e., the volatility is 2% higher than the non-dotcom period. Note that we only include the main effects and their interaction effects in testing the two hypotheses.

There are many factors that are known to affect stock price volatility to some degree, for example, interest rates and financial leverage (Christie 1982). Thus, there could be other control variables that need to be added to equations 1–4. Most of the factors known to affect price volatility are very unlikely to affect our results because we compare two industry groups. There is one factor, namely, financial leverage, that is relevant to our work. Financial leverage is typically measured as the debt to equity ratio of a firm. Leverage reflects the firm’s ownership structure which may have a direct effect on stock volatility. Theory and empirical evidence suggests that leverage statistically affects stock volatility, although the effect is small (Christie 1982; Schwert 1989). Moreover, our data shows that utility firms tend to have higher leverage than IT firms: most utility firms’ have a debt to equity ratio (DER) above 1.2 while that of IT firms’ are below 0.5. The Water Supply and Irrigation System sector has a DER of 6.9, while the Software Publishers sector has a DER of 0.14. We included leverage as a control variable in equations 1–4 to determine whether it affected our results. All the results discussed above still hold. The leverage variable is marginally significant, consistent with the literature. We do not present the results with leverage due to space limitations and the need to describe exactly how this analysis was conducted. A more detailed discussion and presentation of this analysis will appear in a future version of this paper.

**Exploration of Sector Differences**

In Table 3 we provide summary data at the sector level (6-digit NAICS codes). In the Table, we report the number of firms within each sector and the time period over which there is at least one firm in the data for the events in our study. Note that the firm count is the maximum number of firms (in a year) in this sector during the study period. The values in the column “Volatility Ratio” are the ratio of the market-weighted price change for the firms in each sector on an event day to the S&P 500 change on the same day. The rows are sorted by the “Volatility Ratio”. The utility sectors have NAICS codes beginning with 221, the rest are IT industry sectors. Nine of the sector descriptions include an abbreviation. For these sectors, temporal information on volatility is presented later.

The information in Table 3 indicates that most IT sectors have higher average price volatilities than the utility sectors. Most of the utility sectors are at the bottom of the list. The four sectors at the bottom are utility industry sectors. Interestingly, there are some IT sectors that have an average price volatility that is much closer to the utility sectors than others. Web search portals (Yahoo and Google - row 29), for example have low volatility. These IT services are relatively unaffected by economic news. The demand for these services is relatively stable to changes in economic conditions. This result might appear to be counterintuitive since these firms depend heavily on advertising revenue. However, since the demand for these services (e.g. information search) are relatively unaffected by economic conditions, their stock prices will only be volatile if advertising rates are significantly affected by economic conditions. If advertising revenues are primarily driven by the volume of search demand, the stock prices of Web Search Portals should not be sensitive to changes in economic conditions. In a recent article on Google, Google’s advertising business is referred to as “recession-proof” by Google’s CEO Eric Schmidt. He indicates that Google’s revenues are not affected by economic changes (Lashinsky 2008).

Data Processing, Hosting, and Related Services (row 25), and Computer Facilities Management Services (row 22) are two other IT sectors that have low volatility. This should be expected, since these sectors primarily provide “sustaining IT applications” services. At the top of the Table are the IT sectors that manufacture different types of hardware. Clearly, the demand for hardware is greatly affected by new IT applications. Moving new IT applications to the production stage (i.e., applications in use) frequently requires purchasing new hardware or upgrading existing hardware to accommodate new applications. Hence, when investments in new applications are reduced, the demand for hardware is greatly affected. If firms do not invest in new IT applications, the hardware manufacturing sectors would not be greatly affected by changes in economic conditions. The volatility of the hardware sectors to economic news should decrease. We should note that there could be other explanations for these exploratory results.

\[
\text{Volatility}_{it} = \beta_0 + \beta_1 \times \text{Industry}_i + \beta_2 \times \text{Event}_t + \beta_3 \times \text{Year}_i + \beta_4 \times \text{Dotcom} + \beta_5 \times \text{Industry}_i \times \text{Dotcom} + \varepsilon
\]
For the IT industry as a whole, our analysis suggests that the strategic impact of IT has not changed over time. An intriguing question is whether the volatility of different industry sectors has changed over time. Are some IT sectors becoming more strategic while others are becoming more of a utility? We should expect some sectors to have their volatility change over time as their importance to the development of new IT applications changes. To address this question, we focused our attention on three clusters of sectors (high, medium and low volatility clusters), based on the average volatility ratio: sectors that are more than twice as volatile as the S&P500 (ratio over 2), sectors that are...
moderately more volatile than the S&P500 (ratio between 1 and 2) and those sectors that are less volatile than the S&P500 (ratio less than 1).\(^7\)

Note that most utility sectors belong to the low volatility cluster, most of the sectors that provide IT services belong to the medium volatility cluster, while most of the technology manufacturing sectors belong to the high volatility sector. For statistical reasons (i.e., many sectors have very few firms) and for presentation clarity (too many plots on a single graph make it difficult to decipher) we provide information on a few representative sectors from each cluster in our graphs. From each cluster we chose the top three sectors that contain the most number of firms to reduce data noise.\(^8\) This results in a total of nine sectors, sectors with NAICS codes (and sector abbreviation) 518111 (ISP), 541511 (CCPS) and 334112 (CSDM) from the high volatility cluster; 541512 (CSDS), 511210 (SP) and 334111 (ECM) from the medium volatility cluster, and 518210 (DHRS), 221310 (ESIS) and 221210 (NGD) from the low volatility cluster. Figure 2 depicts the volatility ratio over time for the chosen sectors in each of the three clusters. Note that all sectors contain data from 1980 to 2007 except sector 518111 - the Internet Service Provider (ISP) sector because the ISP sector did not exist prior to 1991.

The volatility ratios in Table 3 and the charts in Figure 2 depicting volatility ratio changes over time provide some interesting anecdotal evidence to support claims that: (a) some IT sectors are a lot like utilities, and (b) new technologies enable firms to obtain competitive advantage for a period of time. Some IT sectors have volatility ratios very close to utility sectors. The IT sector with the lowest volatility (i.e., closest to the Utility industry sectors) are firms that provide IT services related to “sustaining applications.”\(^9\) As a result, IT industry firms that provide these services are not as greatly affected by changes in economic conditions. This provides further support for our assumption that firms first make investments necessary to sustain their current IT applications.

As discussed earlier, some IT sectors have very high volatility ratios, for good reasons. The volatility ratios over time depicted in the graphs in Figure 2 are interesting. The Internet Service Providers (NAICS 518111) first appeared in 1991. The volatility of this sector increased each year, peaking between 1993 and 1995. Essentially, much of the demand for the service provided by this sector was due to new applications that firms were developing immediately after the service was introduced. After 1995, sector volatility tapered off but still maintained a high level. It still was much more volatile than the utility sectors, suggesting that it still was an important component of new IT applications. The Electronic Computer Manufacturing sector (NAICS 334111) in the medium cluster depicts a similar pattern. This sector includes most of the PC makers such as Dell, Gateway, Compaq and NEC. This sector was very volatile between 1983 and 1985 (the IBM PC was introduced in 1981) and has been less volatile since then.

An interesting sector is the Data Processing, Hosting, and Related Services (NAICS 518210). This sector has very low average volatility as might be expected for firms whose services primarily relate to “sustaining IT applications.” Interestingly, it appears that the volatility of this sector has decreased steadily over time. This could be due to the fact that the role that this sector performs has changed over time. In the early 1980s, this sector provided computing services for firms that could not afford to perform the service in-house because of the high price of computers. It was common for many firms to develop new applications, often their very first computer applications (e.g., payroll, accounts receivable, accounts payable, etc.) that were then run on hardware owned and operated by firms in this sector. Over time, this changed. Even small firms could run their own operations in house and this sector handled the needs of firms that chose to outsource their operations. New IT applications now have a much smaller impact on the demand for their services today.

---

\(^7\) Cluster 1 thus consists of sectors 1-15 (refer to the row ID in Table 3); cluster 2 consists of sectors 16-23 and cluster 3 consists of sectors 24-33. We grouped the two sectors (sector 24 and 25 with ratio 1.08) into cluster 3 because they are close to cluster 3, and, as we explain below, they include a large number of utility-like firms.

\(^8\) Many sectors include only a few firms (1 to 3). Since our focus is on the averages, we chose not to focus on sectors with very few firms. We also did not choose sectors that do not have a reasonably clear indication of the products or services they provide such as “other computer related services” (NAICS 541519) and “other computer peripheral equipment manufacturing” (NAICS 334119).

\(^9\) For example, the sector “ Data Processing, Hosting, and Related Services” with NAICS code 518210, includes firms such as First Data Corp, Automatic Data Processing and CompuMed Inc., to name a few.
Conclusions

Firms are spending a much larger percentage of their IT budgets on products and services that they acquire from external sources than they did a few decades ago, enabling competitors to easily acquire the same products and services that a firm acquires. Recently, this has led to claims that IT is becoming a commodity, providing few opportunities for firms to use IT to obtain competitive advantage. If true, the IT industry and IT-related academic disciplines are in serious trouble. The good news is that we find no evidence that IT is becoming a utility. The strategic importance of IT has not disappeared, nor is it decreasing.

We should note that our study (like all studies that use financial market data to assess value) indicates that financial markets still believe that firms continue to invest in new IT applications, implying that firms have opportunities to obtain competitive advantage with IT. To our knowledge, this is the first study to provide strong evidence that IT continues to be a potential source of competitive advantage for firms. It is a strong first step towards putting to rest claims that IT is becoming a utility. Indirectly, this study suggests that it is not the nascent technology that provides the advantage, but what firms do with the technology that makes the difference (because the nascent technology is rapidly available to all competitors). If it were the nascent technology that provided the advantage, it would be highly unlikely that we would obtain such strong results.

Finer scrutiny of the IT industry indicates that there are substantial differences across IT sectors. The results for the different sectors provides further support that IT offers opportunities for competitive advantage. Our analysis indicates that some IT sectors have been very similar to utilities over the time period of our study. Firms in these sectors primarily offer services that enable firms to sustain their existing operations. Other IT sectors have been very dissimilar to utilities, their products or service offerings have been very important components of the new IT applications developed by firms. Interestingly, the importance of some IT sectors appears to change over time (i.e., their importance to new applications being developed has changed over time). This data suggests that the sector dominated by PC manufacturers provided greater opportunities for competitive advantage in the early 1980s than they have since then. The same pattern is observed for the Internet Service Provider sector.
As noted earlier, R-square in studies such as this one are typically quite low. Our model R-square is moderately high in comparison to most studies of this type. We could increase R-square by identifying more covariates such as market size, market structure etc. We do not believe, however, that our results (inferences) will be affected by such analysis. Our results do not change when we use SIC codes (but the individual sectors are not as meaningful, and some firms are assigned to sectors that are clearly inappropriate). Another possibility is to use non-linear models.

In this study we restricted our analysis to the entire IT industry and sectors within this industry. An analysis at the sector and industry level makes it difficult to study the effects of specific technologies introduced by IT industry firms. Did specific technologies provide competitive advantage opportunities from some time and later become the cost of doing business? Methods similar to those employed in this study could be used to determine whether and for how long a technology provided significant competitive advantage opportunities. In addition, we included all firms in a sector (for which there was data in the CRSP database). Will the results change if we restrict our analysis to the large firms in each sector? Our study spanned the 1980-2007 period. Would these results hold if we extend our analysis to include earlier periods (say from 1970-2007)? In other words, were the opportunities for IT-enabled competitive advantage known to financial markets much earlier than readers of academic journals were made aware of this fact? As noted earlier, articles touting the IT-based competitive advantage opportunities available to firms began to appear in the early 1980s.

The approach developed here can be used to determine whether a product or service continues to provide strategic advantage opportunities. It could also be used to determine whether a product is still in the growth stage or has reached maturity. In the latter case, there are few new users coming on board. New users are less likely to come on board in poor economic times, because it is a “new application” for these users.

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References