

Does the Market Recognize IT-Enabled Competitive Advantage?

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Abstract: There is a belief that the payoffs from investments in IT are difficult to recognize, and therefore a sustained competitive advantage from an IT-enabled strategy is difficult to distinguish from a temporary competitive advantage. We develop a model to test whether market participants are able to recognize a sustained competitive advantage due to an IT-enabled strategy, and test the model empirically. We find that a competitive advantage due to an IT-enabled strategy is discernable by market participants, and as apparent as a competitive advantage obtained through other means.

Key Words: Information Technology, IT Strategy, IT Resources, Competitive Advantage, Sustainability, Firm Performance, Market Measures

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Introduction

Previous studies that have examined the market returns to investments in Information Technology (IT) have found little evidence that the market rewards companies that spend relatively more on IT ([18], [30]). Reviewing the popular press and academic literature for an explanation, a picture starts to emerge that the benefits of investments in IT are particularly difficult to measure ([8], [12]). In this paper, we will attempt to discern if competitive advantages granted by IT-enabled strategies are more or less difficult to discern by market participants than other types of competitive advantage.

We are interested in determining the ability of the market to recognize a sustained competitive advantage. The ability to discern this information will be termed “opaque” or “transparent.” An opaque competitive advantage refers to a sustained competitive advantage that market participants can observe in the near term, but are unable to distinguish from a temporary competitive advantage. A transparent sustained competitive advantage is one where the market can observe the near term advantage, and accurately distinguish it from a temporary competitive advantage.

In the next section, we will discuss the opaque nature of IT investments, and previous work that examined the market return to IT spending. That is followed by a theoretical discussion of how to test for an opaque versus transparent competitive advantage, the empirical tests, results, and conclusion.

LITERATURE REVIEW

Why is IT-Enabled Competitive Advantage Considered Opaque?

Measuring the benefits of IT has been one of the major areas of research in Information Systems (IS) over the last fifteen years ([9], [28]). The conclusion in most of this work has been that IT does not pay off in the same way as traditional investments [26]. Some researchers have gone as far to say that traditional measures of performance do not apply to IT investments, and different metrics are required [8]. According to a study of 200 IT executives by *InformationWeek* magazine, almost 25% have no expectation of being able to measure the return on their company's IT investments [12]. There are several emerging IT valuation measures (see Table 1) that have been introduced in an attempt to respond to the claim that IT units have done a poor job of communicating their value to the organization [24].

Insert Table 1 Approximately Here

If it is difficult for company insiders to measure the return to IT investments ([1], [10]), one could argue that those outside the firm would have even a more difficult time assessing the performance of companies pursuing an IT-enabled strategy. We derive our research question directly from this line of reasoning: is a competitive advantage granted by IT less transparent to market participants than one obtained through other means?

Competitive Advantage

The definition of competitive advantage as it is used here means performing business activities better than the competition. Superiority is established by comparing a company's performance to major competitors in the same industry. Therefore, competitive advantage is

synonymous with superior performance. Differences in how companies perform strategic activities or differences in which strategic activities they choose to perform are the basis of competitive advantage.

Researchers and managers are interested in the relation between strategic actions that a firm takes and its performance relative to the competition [27]. By far the most popular way of measuring performance is with traditional accounting measures. Their popularity is attributed to the fact that accounting measures are publicly available for many firms and capture information on many dimensions of a firm's operations.

Firms that are successful in creating non-replicable complementarities across activities with an IT-enabled strategy will enjoy superior financial performance by raising revenues or decreasing costs. Hence, traditional accounting variables are most likely to capture a technology-enabled advantage. Among the accounting measures, ROA is the most frequently used in the strategic management literature, has been shown to be related to several other measures of financial performance, and has been shown to be the best overall measure of financial performance ([2], [21], [23]).

ROA has been used in studies on the relation between investment in IT and productivity ([6], [18], [31]), as well as in recent studies on the relation between IT and competitive advantage ([7], [29]). However there are several limitations of accounting measures of performance. These include possible bias due to: use of the historical cost principle and conservatism principle, use of different accounting methods, earnings management, and having unrecorded intangible assets. Because of these limitations and other reasons, Barney [5] recommends the use of alternative measures competitive advantage such as market performance measures and Tobin's q. The latter has been used in the IT literature by Bharadwaj *et al.* [8].

From a stakeholder perspective, the increase in shareholders' wealth is the primary goal of the management of a company and, therefore, it should be used for evaluating management's performance.

Market Returns to Investments in IT

Several previous studies have used market measures to assess the impact of IT on the value of the firm and return to shareholders. Bharadwaj *et al.* [8] examine the relation between spending on IT and Tobin's q , the ratio of the market value of a firm's assets to the replacement cost of those assets. Using 631 firms from 1988-1993, they find that the coefficient on IT spending varies from a low of 1.7 to a high of 10.3 in five, single-year regressions. These results show that the market does value IT investments, but is in contrast to studies ([18], [30]) that find infrequent or no return to shareholders as measured by one-year market returns.

Two studies, Hitt and Brynjolfsson [18] and Tam [30] examine the relation between the value of a company's IT, Return on Assets (ROA), and one-year market returns. Hitt and Brynjolfsson [18] examine the relation between IT Stock (the market value of a company's IT systems plus three times the company's spending on IT labor) and numerous performance measures for 1988-1992, including ROA, and one-year total return to shareholders. They find a positive and significant relation between IT stock and ROA in 1988, 1989, and 1990. They find a significant positive relation between IT Stock and one-year return total return in only one year, 1990, out of the five years examined.

Tam [30] performs similar tests to Hitt and Brynjolfsson [18], examining the relation between computer capital (CC) and ROA, one-year total return to shareholders, and other performance measures, for companies in Hong Kong, Malaysia, Singapore, and Taiwan. He estimates CC for companies in these four countries using data from the *Asia Computer*

Directory. The author finds a positive relation between CC and ROA in Singapore and a negative relation between CC and ROA in Taiwan. There is no significant relation between one-year shareholder return and CC in any of the four countries, and no significant relation between one-year shareholder return and a one-year lagged value of CC. These three studies lead directly to the development of the model presented in the following section. Although the market values IT investments, this shows up infrequently in market returns.

Theoretical Model

A competitive advantage due to the successful implementation of an IT-enabled strategy may generate persistent differences in an accounting based measure of performance ([7], [29]), but the same does not hold true for market based performance measures. In particular, the efficient market hypothesis suggests that once information regarding a firm's competitive advantage is received by the market, investors will "bid up" the price of the firm's stock until any excess returns are eliminated [15].

The following model demonstrates why a company with a sustained competitive advantage due to an IT-enabled strategy with a year-after-year performance advantage will not have a higher return to shareholders except in the year this performance advantage becomes known to the market as long as market participants recognize the true nature of the competitive advantage. To do this we develop a simple model relating the differential Return on Assets (ROA) between a pair of firms, investor expectations, and firm equity prices.¹

We may think of a firm's ROA as depending on a wide variety of variables, some related to macroeconomic conditions (interest rates, unemployment, the dollar exchange rate), some related to industry level conditions (industry demand, industry specific technological progress, changes in regulation) and some that are firm specific (labor disputes, internal management

¹ Assuming companies are financed entirely with equity.

conflicts, changes in product line demand). In addition, there may be some variables or events that will affect firms differently depending on whether or not they have an IT-enabled strategy (changes in computer prices, technology). Following this line of thought, consider a firm i in industry j . At time t , this firm's ROA may be written as

$$\mathbf{R}_{ijt} = \mathbf{g}_{jt} + D_{ijt}s_t + \alpha_{ij}\mathbf{u}_{ijt}, \quad (1)$$

where boldface type indicates a random variable.

$\mathbf{g}_{jt} \sim N(R_g, \sigma_g^2)$ is a random variable capturing the impact of economy-wide and industry specific shocks to ROA for firms in industry j . \mathbf{g}_{jt} is assumed to be uniform for firms in a given industry but may vary across industries due to differences in market structure, barriers to entry, capital intensity and the like. α_{ij} is an m -element row vector of firm characteristics with $\alpha^{ij} = (0, 0, \dots, 0)$ for a benchmark firm, $i = 1$, and \mathbf{u}_{ijt} is a vector of m random variables, normally distributed, which determine industry specific shocks to ROA with respect to various firm characteristics.

The term $D_{ijt}s_t$ captures the impact of a firm having an IT-enabled strategy. D_{ijt} is a dummy variable that equals one if company i has an IT-enabled strategy at time t and zero otherwise, and $s_t \sim N(R_s, \sigma_s^2)$ is an economy-wide random variable that captures the average level and variation in ROA for firms with an IT-enabled strategy. If $R_s > 0$, then implementing an IT-enabled strategy confers a competitive advantage that will be reflected in a firm having a greater Return on Assets than other firms in its industry.

Now, consider two firms in the same industry: firm one, which has an IT-enabled strategy, and firm two, which does not. Furthermore, it is assumed that this constitutes the only substantive difference between the firms, so that $\alpha_{1j} = \alpha_{2j} = (0, 0, \dots, 0)$. If having an IT-

enabled strategy confers a competitive advantage on firm one, then the expected difference in ROA is

$$E_t[R_{1jt} - R_{2jt}] = R_s > 0. \quad (2)$$

Equation (2) will serve as the basis for our accounting measure test of competitive advantage. Empirically, if implementing an IT-enabled strategy confers a competitive advantage, the estimated relative ROA will be significantly different from zero.

In order to consider the impact on a firm's equity price of a competitive advantage arising from an IT-enabled strategy, we need to model the impact of IT-enabled strategies on the formation of investor expectations. While in doing so we necessarily adopt some simplifying assumptions, the model is sufficient to illustrate the relationship between the accounting and market based performance measures used in the empirical exercises above.

Most importantly in this regard, we assume that investors are risk neutral. This simplifies the analysis, as it implies that equity prices will depend on expected returns but not their distribution, e.g. variance, or their covariance with the "market." Owing to the proliferation and ready availability of instruments designed to diversify and package risk, e.g. mutual funds and derivatives, and the increase in investor time horizons, this assumption is probably more realistic and less restrictive now than in the past.

Two issues confound addressing risk associated with IT investments. First, the relative novelty of IT implies a relatively high degree of uncertainty regarding returns to IT investment, suggesting the market might demand a premium. In addition, while it was claimed that IT investment would make companies more flexible, insulating them from economy wide shocks, in actuality IT firm profits proved procyclical. These countervailing effects make it difficult *a priori* to sign the expected impact of IT associated risk.

Investors are assumed to know the distributions of s_t , g_{jt} , and u_{ijt} . In addition, in each period t investors have information ϕ_t relevant to forming expectations regarding D_{ijv} for firms $i = 1, 2$ for both the current period and future periods $v = t, t+1, t+2, \dots$. We define $D_{jt} = \{D_{1jt}, D_{2jt}\}$, $\phi_{t,0}$ and $\phi_{t,1}$ such that $E_t(D_{jv} | \phi_{t,0}) = \{0, 0\}$ and $E_t(D_{jv} | \phi_{t,1}) = \{1, 0\}$ for $v = t, t+1, t+2, \dots$. The stream of information starting at time $t = 0$ is denoted $\Phi = \{\phi_t\}_{t=0, \dots, \infty}$.

Define $\Phi(t^*)$ such that $\phi_t = \phi_{t,0}$ for $v < t^*$ and $\phi_t = \phi_{t,1}$ for $v \geq t^*$. This definition corresponds to a situation in which up until period t^* investors expect that neither firm will ever implement an IT-enabled strategy, while in period t^* and thereafter investors believe that firm one will always have an IT-enabled strategy. It follows that in period t^* and beyond investors expect a permanent increase in firm one's relative ROA:

$$E_t(\mathbf{R}_{1jv} - \mathbf{R}_{2jv} | \Phi(t^*)) = \begin{cases} 0, & \text{for all } v \geq t \text{ if } t < t^* \\ R_s, & \text{for all } v \geq t \text{ if } t \geq t^* \end{cases} \quad (3)$$

Thus, if investors come to believe that firm one has gained a competitive advantage due to implementing an IT-enabled strategy resulting in a sustained competitive advantage, they will expect a permanent increase in the first firm's relative ROA.

While the implementation of an IT-enabled strategy results in a permanent increase in relative ROA for the implementing firm, it results only in a one-time increase in the firm's relative stock price. This is because at time t^* and beyond investors expect a higher ROA and thus, at the initial price, excess returns to firm one's stock. Arbitrage eliminates these excess returns by driving up the price of the firm's stock. This argument is a specific application of the efficient market hypothesis.

Assuming all earnings are paid out in dividends and each share of a firm's stock represents n_{ij} dollars of assets, earnings per share in each period will equal n_{ij} multiplied by the expected stream of returns discounted by the cost of equity capital:

$$P_{ijt} = E_t \left[n_{ij} \sum_{v=t+1}^{\infty} (1+r_j)^{-(v-t)} (R_{ijv}) \right]. \quad (4)$$

It follows that given the information stream $\Phi(t^*)$, the price of equity for firm two is constant at

$$P_{2jt} = n_{ij} \left[\frac{R_g}{r_j} \right] \text{ for all } t. \text{ Up until period } t^*, \text{ investors believe that firm one will never implement}$$

an IT-enabled strategy, so $P_{1jt} = n_{ij} \left[\frac{R_g}{r_j} \right]$ for $t < t^*$. However, in periods t^* and beyond

investors believe that firm one will always have an IT-enabled strategy, implying firm one's

equity price will be constant at $P_{1jt} = n_{ij} \left[\frac{R_g + R_s}{r_j} \right]$ for $t \geq t^*$. Thus, in period t^* , firm one's

equity appreciates by

$$\frac{P_{1jt^*} - P_{1jt^*-1}}{P_{1jt^*-1}} = \frac{R_s}{R_g}. \quad (5)$$

Despite its simplifying assumptions, this model is useful in explaining how the successful adoption of a transparent IT-enabled strategy that increases a firm's profitability will be reflected in accounting and market measures of firm performance. As shown in the model, this transparent competitive advantage will show up in the accounting performance measures every year, but in market measures only in the year the advantage becomes known to the market.

Opaque and Transparent Advantages Illustrated

The differences between the transparent competitive advantage demonstrated above and an opaque competitive advantage hypothesized in previous research can be illustrated with a simple numerical example.

Assumptions:

1. There are three companies of interest; each will be compared to a baseline company.
2. The three companies are identical in all respects, except for the visibility and type of their competitive advantage.
3. One of the companies has a temporary competitive advantage, and the other two have a sustainable competitive advantage.
4. A sustainable competitive advantage means that earnings are increased permanently; a temporary competitive advantage means earnings are increased for only one period.
5. The companies pay out all of their earnings as dividends at the end of each period.
6. Stock price is equal to one over the discount rate times expected future dividends.
7. Expected future dividends are equal to the probability that the competitive advantage is permanent, times the amount of dividends from a competitive advantage, plus the probability that the competitive advantage is temporary, times the amount of dividends when there is no competitive advantage (the normal dividend rate).
8. One company's sustainable competitive advantage is transparent, known to the market. The other company's sustainable competitive advantage is opaque, not discernible from a temporary competitive advantage.
9. Any difference in price between the three companies is due solely to the market's knowledge of a company's competitive advantage.
10. There is no difference in risk between the companies.
11. There is no difference in the discount rate between the three companies.

Formulas:

$$\text{Discount Rate} = 10\%$$

$$\text{Asset Price}_{t=0} = 100$$

$$\text{Asset Price} = \frac{\text{Expected Dividend}}{\text{Discount Rate}}$$

$$\text{Expected Dividend} = D_E = p(D_P) \times D_{CA} + p(D_T) \times D_N$$

Where:

$$p(D_P) = \text{the probability of a permanent dividend increase}$$

- D_{CA} = the amount of dividend from a competitive advantage
- $p(D_T)$ = the probability of a temporary dividend increase
- D_N = the amount of dividend when a firm does not have a competitive advantage (the normal dividend amount)

$$\text{Return} = \frac{\text{Price}_t - \text{Price}_{t-1} + \text{Dividend}_t}{\text{Price}_{t-1}}$$

Baseline Company

Period:	1	2	3	4	5	...
Expected Next Period Dividend	10	10	10	10	10	10
Current Period Actual Dividend	10	10	10	10	10	10
End-of-Period Stock Price	100	100	100	100	100	100
Return	10%	10%	10%	10%	10%	10%

Company 1 -- Temporary Competitive Advantage

Company 1 increases earnings and dividends for a single period.

Period:	1	2	3	4	5	...
Expected Next Period Dividend	10	10	10	10	10	10
Current Period Actual Dividend	10	10	20	10	10	10
End-of-Period Stock Price	100	100	100	100	100	100
Return	10%	10%	20%	10%	10%	10%

Results: Company 1

The company with a temporary competitive advantage will have returns that are higher than the baseline company in only one period, the period in which the company has higher earnings and dividends.

Company 2 -- Transparent Sustainable Competitive Advantage

Company 2 is able to permanently increase earnings and dividends, and this is understood perfectly by market participants. Market participants know with 100% certainty that the dividend increase is permanent, therefore $D_E = 100\% \times 20 + 0\% \times 10 = 20$.

Period:	1	2	3	4	5	...
Expected Next Period Dividend	10	10	20	20	20	20
Current Period Actual Dividend	10	10	20	20	20	20
End-of-Period Stock Price	100	100	200	200	200	200
Return	10%	10%	120%	10%	10%	10%

Results: Company 2

The company with a transparent sustainable competitive advantage will have returns that are higher than the baseline company in only one period, the period that the sustainable competitive advantage becomes known to the market.

Company 3 -- Opaque Sustainable Competitive Advantage

Company 3 is able to permanently increase earnings and dividends, but market participants do not know if the dividend increase is permanent, therefore $D_E = 50\% \times 20 + 50\% \times 10 = 15$.²

Period:	1	2	3	4	5	...
Expected Next Period Dividend	10	10	15	15	15	15
Current Period Actual Dividend	10	10	20	20	20	20
End-of-Period Stock Price	100	100	150	150	150	150
Return	10%	10%	70%	13%	13%	13%

² For simplicity, we assume that market participants assign a probability of 50% that the increase is permanent. Varying this percentage does not affect the interpretation of the results, only the magnitude of the differences.

Results: Company 3

The company with an opaque sustainable competitive advantage will have returns that are higher than the baseline company in every period in which the company has higher earnings.

RESEARCH QUESTION

Based on the discussion above, we are interested in determining the ability of the market to recognize a sustained competitive advantage due to an IT-enabled strategy. Will the pattern of market returns for companies with an IT-enabled competitive advantage resemble that of Company 2 (transparent) or Company 3 (opaque) in the example above? In addition, does this pattern differ for companies with a non-IT-enabled competitive advantage? As previously discussed, a competitive advantage due to IT is usually believed to be less transparent than other types of competitive advantage.

To test this empirically, two groups must be identified, one with a competitive advantage due to IT, and one due to other means. It will be shown that both groups have a similar competitive advantage, as measured by Return on Assets. Then, by comparing the market returns to these two groups, we should be able to gauge the transparency of their competitive advantage.

A competitive advantage will be judged transparent if ROA is significantly higher every year for an extended period, but the market return is only different in a single year. A competitive advantage will be judged opaque if ROA is significantly higher every year for an extended period, and the market return is significantly higher over the same period. We expect that the competitive advantage due to an IT-enabled strategy will be less transparent (more opaque) to market participants than other types of competitive advantage.

METHODOLOGY

Data Set

The *Computerworld* Premiere 100 (CWP100) will be used to identify companies with an IT-enabled competitive advantage. Each year from 1989 to 1993 *Computerworld* selected the 100 most successful users of IT, based on nine criteria:³ total spending on IS as a percentage of revenue, total spending on IS staff as a percentage of total IS spending, total spending on IS staff training as a percentage of total IS spending, total market value of the company's IS systems as a percentage of revenue, percentage of employees with a computer or terminal, peer rating of the most successful users of IS within their industry, a rating of how well IS management has positioned the information systems to service business needs, how well top management has positioned the information systems to match the business needs of the organization, and five year growth rate in profits. In 1993, the peer evaluation component carried double weight in the creation of the final weighted average score that was used for the ranking of the companies [11].

These criteria identify companies committed to IT (total spending on IS as a percentage of revenue), that are using IT successfully (peer rating of the most successful users of IS within their industry), as part of an IT-enabled strategy (how well the IS is positioned to match the business needs of the organization).

Computerworld has identified companies that use an IT-enabled strategy to gain a competitive advantage. By default, companies that have a competitive advantage but were not selected by *Computerworld* used a less IT-enabled strategy. To identify companies with a competitive advantage that is not necessarily IT-enabled, we will use the top performing companies within each industry that do not appear on the *Computerworld* Premiere 100 list (the TOP100). Specifically, the top ten percent of all large companies on an aggregate financial

³ *Computerworld* changed the selection process in 1994.

performance measure will be used to identify the top performers within each industry. Using companies from a broad cross-section of industries gives the TOP100 an industry representation similar to that of the CWP100. Only companies with total assets and sales greater than \$400 million were considered for the TOP100 because that is the approximate size of the smallest CWP100 company.

The aggregate performance measure used to select the TOP100 companies combines Gross Profit Margin, Operating Profit Margin, Return on Sales, Return on Assets, Return on Equity, and Return on Investment, using principle components factor analysis.⁴ An aggregate performance measure was used based on the recommendation that multiple measures of performance be used to identify companies with a competitive advantage ([32], [5]). In addition, multiple performance measures were used in previous research in the analysis of the role of IT and competitive advantage ([7], [29]).

A matched-pair design is used to test the research questions. The CWP100 and the TOP100 were matched with their direct competitors using industry (SIC code) and size (total assets and sales). This matching controls for industry effects, size, and capital intensity as alternative explanations for any difference found in performance between the two groups. This resulted in two sets of companies with a competitive advantage (the CWP100 and TOP100), each matched with their nearest competitor.

Each CWP100 and TOP100 company was matched with their closest competitor using the following procedure. First, all companies with the same primary 4 digit SIC code as the CWP100/TOP100 company were identified. Second, any company twice as large or half as small as the CWP100/TOP100 company on sales or total assets was removed from the list of

⁴ All financial data comes from the Compustat Research Insight Database.

potential matches.⁵ The nearest competitor was then identified as the company with closest sales and total assets to the target company.

There were no matches for seven companies in the CWP100. The total number of firm pairs varies due to data item availability on the Compustat Research Insight and Center for Research in Security Prices (CRSP) databases. After eliminating firm-pairs without matches and without data on the databases, there were 65 pairs of CWP100 companies and 87 pairs of TOP100 companies in the final study. A reconciliation of the original CWP100 companies and the 65 used in this study is shown in Table 2.

Insert Table 2 Approximately Here

The results of the industry matching and the relative size of the groups of companies can be found in Table 3 and Table 4. Table 3 shows the success in matching by SIC code, and Table 4 provides summary statistics for the groups in terms of total assets and net sales. By design, the groups should have mean sales and total assets that are approximately equal.

Insert Table 3 and Table 4 Approximately Here

Statistical Tests

Because the distribution of financial ratios tends to be non-normal ([3], [4], [13], [16], and [19]), non-parametric statistics were used to test for differences between the experimental groups and the matched control groups. The non-parametric test used is the Wilcoxon signed

⁵ If there was no competitor that was no more than twice as large or half as small as the CWP100 company, 3 digit and 2 digit SIC code industry groups were used to find the nearest competitor.

rank test for matched pairs, the recommended test in cases of paired-data where the normality of the data is questionable [22]. All tests were replicated with a t-test and sign test and there were no substantive differences.

The empirical tests consist of using ROA to identify companies with a competitive advantage (the CWP100 and TOP100), and then to compare them to their direct competitors using market measures. Barney (1997) recommends the use of several different market-based measures to evaluate competitive advantage. To measure the market returns of firms with a competitive advantage, principal components factor analysis will be used to combine five widely used market performance measures into one overall measure of market performance. These five measures are the Sharpe Performance Index, the Treynor Performance Index, Total Return, Risk Adjusted Cumulative Abnormal Return, and Market Adjusted Cumulative Abnormal Return. Each of the performance measures is defined in Table 5. All market data comes from the CRSP database.

Insert Table 5 Approximately Here

RESULTS

The results of the statistical tests can be found in Table 6. Each Panel in Table 6 contains a side-by-side comparison of two tests; the first is in terms of ROA, while the second is in terms of our market measure. Each test compares the set of companies with a competitive advantage to the matched control group.

In Panel 1, the ROA test facilitates a comparison between the CWP100 companies and their direct competitors. This test allows us to establish the extent to which the CWP100

companies have an IT-enabled competitive advantage versus their direct competitors. Based on the reported p-values for the Wilcoxon test, the CWP100 had statistically significant higher ROA in every year from 1989 to 1996, and in 1998.

In Panel 2, the ROA test makes possible a comparison between the TOP100 companies and their direct competitors. This test allows us to establish the extent to which the TOP100 companies have a competitive advantage versus their direct competitors. As shown in Panel 2, the TOP100 had statistically significant higher ROA in every year from 1987 to 1998.

Examining the market results in Panel 1 and Panel 2, allows us to assess whether the competitive advantage of each group of companies is transparent or opaque. In Panel 1, the comparison of market returns of the CWP100 and their competitors indicates that the CWP100 had statistical significantly higher market returns in 1991 and 1998. In the light of our theoretical model,⁶ this signifies that IT-enabled competitive advantage, such as the one enjoyed by CWP100 companies, is transparent. In Panel 2, the market tests indicate that the TOP100 had statistical significantly higher market returns in 1989-1991, and 1995. As defined earlier, the competitive advantage enjoyed by the TOP100 is also transparent, but not as transparent as the competitive advantage held by the CWP100. This result is in direct contradiction to the literature reviewed earlier that states that a competitive advantage granted by IT may be difficult to distinguish.

Insert Table 6 Approximately Here

One interesting result is the higher returns enjoyed by the control group over the CWP100 companies in 1993. In a world of imperfect information, it may be that during the

⁶ See scenario for Company 2, Transparent Sustainable Competitive Advantage.

period under investigation investors were still learning how to generate expectations regarding the impact of an IT-enabled strategy on firm performance. If, as part of this process, investors revised their expectations downward, it would result in a one-time decrease in a firm's equity price. Such a revision may provide a partial explanation for the statistically significant lower market returns to the CWP100 in 1993. Note that this holds even if investors still hold that having an IT strategy is advantageous. A fall in the market return is consistent with a reduction in the expected gains from an IT-enabled strategy, even if the gains are still held to be positive.

CONCLUSION

Although there is an appealing argument for using market measures to gauge competitive advantage ([5], pp. 54-63), in practice it is difficult because the period of competitive advantage is less important than knowing when the competitive advantage became known to the market. Researchers looking through a "crystal ball" at the past can only guess when market participants fully understood the competitive advantage granted by investments in IT. One alternative that has been moderately successful has been the event-study methodology (e.g. [14], [20]). In this methodology, researchers gauge the market returns immediately following company's announcements of IT initiatives, believing that it is at this time the market becomes aware of any future competitive advantage. A problem with this type of research is that any actual competitive advantage may or may not develop, in which case the market returns are premature. Two studies in particular demonstrate this conundrum.

Hayes *et al.* [17] use an event-study methodology to examine the stock market reaction to ERP implementation announcements. They study the extent to which ERP Systems are deemed to add market value to business organizations. They find an overall positive reaction to initial ERP announcements. This is in direct contradiction to the Poston and Grabski [25] findings of

little benefit to the adoption of ERP systems. Most likely this is due to the market anticipating that benefits will accrue to the average firm, but are unable to determine *ex ante* which firms will actually gain a competitive advantage. Hayes *et al.* [17] attempt to separate out the companies that will benefit and those that will not, and find the market reaction to be most positive for small/healthy firms and for those who engage larger ERP vendors (such as PeopleSoft and SAP). This type of *ex ante* categorization of firms most likely to gain a competitive advantage due to IT-enabled strategies are the most likely to improve our understanding of market participant's beliefs in establishing market returns. Therefore, our advice for future research is more *ex ante* theory on where we should expect market returns to accrue, and tests of these predictions using both event studies and valuation studies (e.g. Tobin's q).

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TABLES

Table 1
Emerging IT Valuation Measures

<i>Applied Information Economics</i>	Uses scientific and mathematical methods to evaluate the IT investment process.
<i>Balanced Scorecard</i>	Integrates traditional financial measures with three other key performance indicators: customer perspectives, internal business processes and organizational growth, learning and innovation.
<i>Economic Value Added</i>	Calculates "true" economic profit by subtracting the cost of all capital invested in an enterprise—including technology—from net operating profit.
<i>Economic Value Sourced</i>	Quantifies the dollar values of risk and time and adds these into the valuation equation.
<i>Portfolio Management</i>	Manages IT assets from an investment perspective by calculating risks, yields and benefits.
<i>Real Option Valuation</i>	Values corporate flexibility above all else; tracks "assets in place" and "growth options" to present the widest array of future possibilities.

Table 2

Reconciliation of the Original *Computerworld* Premiere 100 Companies and the 65 *Computerworld* Premiere 100 Companies in the Study.

Total Number of CWP100 companies.	100
CWP100 Companies without full data on Compustat 1987-1998	22
CWP100 Companies or their matches without full data on CRSP 1987-1998	6
Number of Unmatched CWP100 Companies	<u>7</u>
Total Firm Pairs	65

Table 3

Industry matching by SIC code for the *Computerworld* Premiere 100 (CWP100) Companies and Top 100 Industry Performers (TOP100).

	CWP100	TOP100
Firms matched on 4 digit SIC Code.	61%	70%
Firms matched on 3 digit SIC Code.	11%	5%
Firms matched on 2 digit SIC Code.	28%	25%

Table 4

Comparative Statistics (Year=1993)

<u>Variable</u>	<u>Group</u>	<u>N</u>	<u>Mean</u>	<u>Standard Deviation</u>
	CWP100	65	10,520	18,189
TOTAL	Control	65	10,906	22,030
ASSETS	TOP100	87	12,172	24,191
	Control	87	12,125	25,486
	CWP100	65	6,503	9,244
SALES	Control	65	5,949	6,563
	TOP100	87	6,303	15,677
	Control	87	5,790	12,525

(dollar amounts in millions)

Table 5
Performance Variables

Ratio	Calculation	Interpretation
Return on Assets (ROA)	Income available to common shareholders from continuing operations divided by average total assets.	Measures profitability and how efficiently assets were employed during the period.
Total Return (CR)	Change in price for the year plus dividends divided by beginning of year price.	Total shareholder return for the period.
Risk Adjusted Cumulative Abnormal Return (CAR)	Geometric sum of the daily abnormal returns adjusted using Beta from the market model for the previous year.	Total shareholder return adjusted for systematic risk.
Market Adjusted Cumulative Abnormal Return (CARMA)	Geometric sum of the daily abnormal returns adjusted for overall market performance. (Same as above with assumption that Beta=1).	Total shareholder return above or below the market as a whole.
Sharpe Performance Index	Total return minus the risk free rate divided by the standard deviation of daily returns.	Excess return earned for the year per unit of total risk.
Treynor Performance Index	Total return minus the risk free rate divided by Beta.	Excess return earned for the year per unit of systematic risk.

Table 6
Return on Asset Performance vs. Market Performance

Panel 1
Computerworld Premiere 100 vs. Matched Control Group

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
ROA	0.07	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.10	0.01
Market	0.69	0.39	0.58	0.31	0.05	0.30	1.00*	0.12	0.29	0.70	0.48	0.01

One-tailed p-values for the Wilcoxon signed rank test for matched pairs.

* Results reported are one-tailed tests, so the reported p-value of 1.00 in 1993 indicates that the matched control group significantly outperformed the CWP100 using a two-tailed test.

Panel 2
Top 100 Industry Performers vs. Matched Control Group

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
ROA	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Market	0.10	0.12	0.00	0.00	0.04	0.41	0.60	0.57	0.02	0.25	0.46	0.34

One-tailed p-values for the Wilcoxon signed rank test for matched pairs.