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# Sustainable value creation: The role of IT innovation persistence

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**ABSTRACT:**

In this research, we investigate the role of alternative IT innovation strategies (systematic, opportunistic, and non-IT innovation) on earnings persistence. Building on agility theory we argue that systematic IT innovation leads to sustainable value creation and ability to recover from negative earnings and recession. Using a sample of large US firms we find that good (bad) performance of systematic IT innovators is more persistent (transitory) than non-systematic IT innovators, and are more likely to recover from recession. We conclude that systematic IT innovators are better prepared to deal with the modern hypercompetitive environment.

**Keywords**
Systematic IT innovation, sustainable value creation, earnings persistence, agility theory

## INTRODUCTION

With the major industrialized economies already in a recession (Economist 2008), managers are looking for robust strategies to navigate their companies through the earnings storm. Guidelines from consulting firms and journalists abound and most of them involve suggestions regarding IT strategies (Cummings 2008; McKinsey Quarterly 2008). Understanding what IT strategies might work well during a recession or could help a company bounce back from a string of negative earnings is critical for managers and investors. This knowledge could be translated into persistent high profitability (earnings) and sustainable competitive advantage.

In economic and accounting literature, earnings persistence represents the ability of firms to preserve their preferential competitive position (high earnings) for considerable periods of time (Stigler 1963; Lev 1983). Prior studies have identified various economic characteristics such as barriers-to-entry, size, product-type, capital intensity, and R&D that drive earnings persistence (Stigler, 1963; Lev, 1983; Baginski et al., 1999; Asthana and Zhang 2006). Approaching this literature from an IT perspective, we see two opportunities to make a positive contribution. First, IT spending has been rising and it has become the largest capital spending item for most companies (Weill et al. 2002). In spite of this and the recognition of IT enabled strategies as a source of sustainable competitive advantage (Sambamurthy et al. 2003; Piccoli and Ives 2005), our search of the extant literature shows no evidence of prior research linking IT (resources and capabilities and/or strategy) to earnings persistence. Second, while prior research on earnings persistence has looked at the role of certain economic factors on a company's ability to bounce back from a string of negative earnings (Chamber 2006), no attempt has been made to analyze and compare earnings persistence between a recession and a recovery period. Hence, the main question of our study is: What is the role of IT on earnings persistence and how this differs during a business cycle?

A recent study (Stratopoulos and Lim 2007), has defined *IT innovation persistence* as a firm's ability to differentiate itself from its peers and stand out in a crowd of competitors through IT innovations over an extended period of time. Approaching IT innovation as a zero-sum game, Stratopoulos and Lim (2007) show that IT innovation is a heterogeneously distributed and imperfect mobile capability, hence a source of sustainable competitive advantage. They attribute persistence to the path dependence of the IT innovation. This means that companies that have been able to distinguish themselves from their competitors through IT innovation in the past are more likely to repeat this in the current period. In our study, we argue that

IT innovation persistence is linked to earnings persistence, and companies that have developed such an IT innovation capability are more likely to deal with recessions and drops in earnings more efficiently than companies that have not developed similar capabilities. Our econometric analysis shows that, at least within the group of large US firms in our sample, the IT capability leads to not only high profitability (abnormal return on earnings) but also high ability to recover from earnings drops and economic downturn, as indicated by the change in their earnings persistence between the good and bad financial performance years, or between the recession and recovery periods.

The rest of the paper is structured as follows. In the following section we review the work on IT business value and IT innovation. Thereafter, we discuss the theoretical framework used to govern our discussion and to identify the measures considered in this study. The research methodology and the results of an empirical analysis are then presented. Finally, the implications for practitioners and researchers are outlined and conclusions and limitations of the study are presented.

## LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Firms today face intense competition in an increasingly turbulent and dynamic global market (D'Aveni 1994; Sambamurthy 2000). This manifests in higher volatility of earnings, increased incidents of "performance slumps" among *Fortune 500* companies, and stories of companies with superior past performance record having difficulty delivering consistently superior earnings in recent years (Hamel and Välikangas 2003). This trend has serious implications for managers and investors since earnings persistence (a measure of the company's sustainable competitive advantage) is more desirable than transitory earnings (a temporary competitive advantage). In economic and accounting literature earnings persistence has been linked to various economic characteristics such as barriers-to-entry, size, product-type, capital intensity, and R&D (Stigler, 1963; Lev, 1983; Baginski et al., 1999; Asthana and Zhang 2006).

In this study we introduce a company's approach to IT innovation (IT innovation strategy) as a determinant of earnings persistence. In terms of IT innovation strategies firms can be classified as innovative or non-innovative. Among the group of IT-innovative firms, a distinction has been made between those that are systematic and those that are opportunistic innovators in terms of attributes and their approach to IT innovation strategy (Swanson and Ramiller 1997; Stratopoulos and Lim 2007). *Systematic IT innovators* seem to be taking a long-term and strategic approach to IT innovation. *Opportunistic IT innovators*, on the other hand, will tend to take a short-term approach driven by fashion or fads (Abrahamson and Rosenkopf 1997; Swanson and Ramiller 1997).[1] Using a cross-sectional data set of large US firms from 1997-2004, Stratopoulos and Lim (2007) have shown that IT innovation capability is heterogeneously distributed and not easy to imitate, and over an extended period of time, it is more likely for systematic IT innovators to continue being systematic innovators than for opportunistic and non-IT innovators to become systematic innovators. In the following paragraphs we build on the IT innovation persistence of the systematic IT innovators in order to establish the theoretical link between IT innovation strategies and earnings persistence.

### Hypotheses Development

#### *H1: IT Innovation Strategies and Value Creation.*

It is an empirical fact that some firms outperform others and strategy theories try to explain this (Powell 2003). In fact the purpose of firm strategies and measure of success is its ability to create value. This occurs when a firm generates earnings, which are greater than its cost of capital. *Residual income* (abnormal ROE) is such a measure of performance that captures value creation that has been adopted in accounting (Feltham and Ohlson 1995; Ohlson 2001; Cheng 2005) and strategic management literature (Hawawini et al. SMJ 2005). Since the main objective of our study is to consider the effect of IT innovation strategies, it makes sense that we should consider a measure of performance that reflects value creation.

Following the suggestion of Kohli and Grover (2008; p. 30) we start by uncovering the capabilities required for value and then identify what it takes to build them. Business agility is a critical factor for success in today's dynamic competitive environment (D'Aveni 1994; Brown and Eisenhardt 1997; Sambamurthy 2000; Sambamurthy et al. 2003). In our study we will adopt the following definition for business agility proposed by van Oosterhout et al. (2007: 53-54):

> *"Business agility is the ability to sense highly uncertain external and internal changes, and respond to them reactively or proactively, based on innovation of the internal operational processes, involving the customer in*

[1] In the rest of our discussion we use the terms systematic/opportunistic IT innovators and systematic/opportunistic IT innovation strategy interchangeably.

> *exploration and exploitation activities, while leveraging the capabilities of partners in the business network."* (van Oosterhout et al. 2007)

This definition captures the three dimensions of agility: customer, partnering, and operational agility. Sambamurthy et al. (2003) argue that firms that can bundle these three dimensions of agility are more likely to outperform their competitors by launching a higher number and more complex competitive actions. Piccoli and Ives (2005) claim that strategic IS research has been "invigorated" by recent studies (Sambamurthy et al. 2003; Weill et al. 2002) that have linked IT with business agility. Building on the work of Sambamurthy et al. (2003) and Bharadwaj et al. (1999), we see the following link between dimensions of business agility and IT capabilities:

The building of e*xternal IT linkages* capability refers to connections between the firm and business partners that nurture the sharing of knowledge (Konsynski and McFarlan 1990; Zaheer and Venkatraman 1994) and prepare the firm to explore IT opportunities within the firm as well as with external partners (Feeny and Wilcocks 1998; Bharadwaj et al. 1999). This capability is the foundation for the development of customer and partner agility. A company's operational agility and ability to innovate on its internal operational processes will rest on the building of *IT business partnerships*, i.e., ability to foster relationships between IT providers and IT users. IT business partnerships are critical for developing IT innovation (Reich and Kaarst-Brown 2003). Finally, a firm's ability to sense highly uncertain external and internal changes, and respond to them reactively or proactively will be related to the *Business IT strategic* capability.

Swanson and Rasmiller (1997) argue that firms that systematically innovate with IT seem to be more attuned to the idiosyncrasies of their internal environment (IT business partnership capability) as well as the external environment (external IT linkages), and they tend to promote interactive learning (IT business partnership capability). Such IT-innovative firms are also more likely to succeed if senior management perceives IT innovation as an important capability and supports it (IT management and IT strategic thinking capability). Therefore companies that have been systematic IT innovators are more likely to have these capabilities for developing business agility than opportunistic and non-IT innovators. Thus we develop the following hypothesis:

> *H1: Systematic IT innovative firms are more positively associated with abnormal ROE than opportunistic and non-IT innovative firms.*

#### *H2: IT innovation strategies and sustainable value creation*

Value creation that resists the erosion from competitors' actions is consistent with Porter's (1985) definition of sustainable competitive advantage, and it should be distinguished from occasional spikes in value creation that are associated with a temporary competitive advantage. Managers and investors recognize the importance of earnings persistence, a manifestation of sustainable value creation (Collins and Kothari, 1989; Barth et al., 1999; Asthana and Zhang 2006). However, earnings persistence is differently affected by good news and bad news; good news is defined as positive abnormal ROE, and bad news is defined as non-positive abnormal ROE. Prior studies have linked earnings persistence to various economic characteristics and have explored their contribution to persistence of good news and transitory bad news (Stigler, 1963; Lev, 1983; Chamber, 1996; Baginski et al., 1999; Asthana and Zhang 2006). Here we introduce IT innovation strategies as an explanatory variable of persistence of positive earnings and transitory negative earnings.

According to Resource Based View (RBV), only resources and capabilities that are valuable, heterogeneously distributed, *and* imperfectly mobile will confer a sustained competitive advantage (Barney 1991; Mata et al. 1995). Stratopoulos and Lim (2007) have shown that IT innovation is a path dependent process, and hence not easily replicated. Companies that have been able to distinguish themselves from their competitors through IT innovation, and they have been able to repeat this over an extended time period (i.e., Systematic IT innovators) are more likely to continue being systematic innovators than for opportunistic and non-IT innovators to become systematic innovators. Therefore, systematic IT innovation strategy is more likely to lead to sustainable value creation (positive earnings) than non-systematic IT innovation strategies.

In addition, we have seen that systematic IT innovators are more likely to have developed the IT capabilities (IT business partnerships, external IT linkage, as well as IT management and IT strategic thinking) needed for business agility. Firms with high levels of customer, partnering, and operational agility are better positioned to detect and exploit market opportunities (Sambamurthy et al. 2003). Therefore, systematic innovators are more likely and better prepared to respond to negative earnings shocks than opportunistic and non-IT innovators. Thus, we conjecture:

> *H2a: Systematic IT innovative firms are more likely to have positive persistent abnormal ROE (good news) than opportunistic and non- IT innovative firms.*

*H2b: Systematic IT innovative firms are more likely to have less persistent (transitory) negative abnormal ROE (bad news) than opportunistic and non- IT innovative firms.*

*H3: IT innovation strategies and sustainable value creation during Business Cycles*

An article with the title "How to Think Strategically in a Recession - Strategy for the Recession" was published in Harvard Management Update shortly after the 9/11 attacks. The article (Zook and Rigby 2001) suggested that managers should consider to what extent their company was prepared to deal with the following scenarios/challenges: Is your company prepared to deal with supply chain disruptions? Will you be able to survive in a price war (prices drop drastically)? Is your company prepared for a global recession? While the list is not exhaustive, it certainly captures the main challenges that a company is likely to face during a recession. Failure to deal with these challenges would have a detrimental effect on the company ability to create and sustain value.

In order to deal with the first of these challenges, companies will need to focus on what Weill et al. (2003) call supply-side initiatives (partnering agility) and operational initiatives (operational agility). Leveraging their external IT linkage capabilities and business IT partnership capabilities, companies can reach the level of agility that Dell attained in the days after the 9/11 attacks.

*" ... Dell, which has built one of the world's best supply chain networks, chartered an airliner to fly parts from Taiwan to its Texas factory, ran factories day and night, and converted three 18-wheel trucks into mobile technology and support facilities in order to supply 24,000 computers to New York City and Washington, D.C"* (Zook and Rigby 2001)

The second and third challenge relate to the following two intertwined patterns that companies are more likely to face during an economic recession: First, customers tend to become more price sensitive. Second, companies are more likely to engage in price wars (Chou and Chen 2004). During a period of economic expansion, both high- and low-cost producers can be profitable. However, during the recession, when prices are falling, only the low-cost producers will be profitable (Zook and Rigby 2001).

*"...Intel has cut prices on its microprocessors by 35%. Dell halved its prices and still makes money—not so for some of its competitors. The speed of the economy's decline from its high point eighteen months ago will soon underscore the importance of relative cost position."*

Companies that have developed what Weill et al. (2003) call demand-side initiatives (customer agility) and operational initiatives (operational agility) are more likely to succeed n such an environment of increased price elasticity of customers and price wars. Operational initiatives leading to improved cost position will be possible for companies that can leverage their business IT partnership capabilities and external IT linkages with partners. The former in order to exploit opportunities to reduces inefficiencies in their value chain and identify opportunities to cut cost, and the latter to improve the efficiency of their supply chain. However, these operational changes should be done in way that does not sacrifice the service that the company offers to its customers. Such customer agility will be feasible for companies that can leverage the external IT linkages with customers.

As we have seen, Systematic IT innovators are more likely to have developed the IT capabilities (IT business partnerships and external IT linkage) needed for a company to respond to the challenges of an economic recession. Therefore, systematic innovators are more likely and better prepared to weather an economic recession than opportunistic and non-IT innovators. Therefore we conjecture that:

*H3a: Systematic IT innovative firms are more likely to have persistent abnormal ROE in recovery period than opportunistic and non- IT innovative firms.*

*H3b: Systematic IT innovative firms are more likely to have less persistent (transitory) abnormal ROE in recession period than opportunistic and non- IT innovative firms.*

## METHOD

### 3.1 Sample

To identify firms' approach to IT innovation within an industry, we followed the methodology used by Stratopoulos and Lim (2007). We obtained data from *InformationWeek 500 (IW500)* from 1997 to 2004[2]. Conducting a detailed survey of IT

[2] This period was chosen because it contains the approximate boundaries of a complete cycle in managers' perception regarding innovation with IT (Stratopoulos and Lim 2007). The period was marked by a sequence of events that one can

executives, *IW500* publishes an annual list of the largest US companies ranked by their innovative use of IT, business-technology strategies, and deployment of investments in IT architecture, infrastructure, business, and e-business application. The end result is an annual list of *IW500* firms that are classified as IT innovators due to their demonstration of a "consistent pattern of technological, procedural, and organizational innovation." (InformationWeek 500 Research Reports – various issues 1997-2004). The publicly available data from *IW500* source have been commonly used in a number of studies in the past (Bharadwaj et al. 1999; Bharadwaj 200; Brynjolfsson and Hitt 1996; Hitt and Brynjolfsson 1996; Lichtenberg 1995; Santhanam and Hartono 2003; Stratopoulos and Lim 2007).

[Insert Table 1]

Using the listing of IT innovative firms from *IW500*, the initial step produced 4,000 records of firms (firm-entries) that have attained the IT innovator status on any year from 1997-2004. However, among those firms there were 588 entries associated with private, non-profit, foreign, or bankrupt firms for which we would not be able to produce financial performance data. Eliminating these entries reduced our records to 3,412 corresponding to 1,067 unique firms from *IW500*. For our second step, we used data from *Hoover's Handbook of American Business (Hoovers),* which has involved in the preparation of the *IW500* report as a provider of corporate financial data, as well as identified the list of non-IT innovative firms that are also perceived to be the top competitors for each of the IT-innovative firms (Stratopoulos and Lim 2007). In fact, we matched the top three competitors for each IT innovative firms; specifically, a further manual review was conducted for eliminating 107 competitors with missing either size or industry value from *Hoover's*. The final data contain 960 firms by 622 IT-innovative firms from *IW500* and 338 non-IT- innovative firms from *Hoover's*.

We restrict the sample to include firm-year observations with financial data from Compustat. A cross-match with the Global Vantage Key (GVKey) file from Compustat resulted in the elimination of another 26 firms. Thus, 934 unique firms remained in our sample, giving us a total of 4,670 firm-year observations for our testing period 2000~2004. Our test requires the initial three-year data for the period 1997~1999 to derive the systematic IT innovation data for each firm. We further eliminate 1,393 firm-year observations of missing current and one-year ahead ROE, and 84 firm-year observations of top and bottom one percent extreme values in ROE and abnormal ROE values. This leaves us a total of 3,193 firm-year observations for the testing period 2000~2004, representing 712 unique firms (about an average of 639 firms in each year). In our analysis, we apply our IT innovation data from the sample period 2000~2004 to forecast one-year lead abnormal ROE for the forecast period 2001~2005.

According to National Bureau of Economic Research (NBER), the technical definition of a recession is that of two consecutive quarters of GDP decline; based on this the US economy officially peaked (entered the recession) in March 2001 with the burst of the dot-com bubble and collapse of NASDAQ. The economy reached its trough (end of recession) in November 2001 (NBER 2001, 2003a, 2003b). However, the period from the fall of 2001 till the summer of 2003 was marked by several events indicating the economy was not in recovery state yet. First, the stock market and the economy suffered after the September 11, 2001 attacks. Second, industries that lost jobs during the recession continued shrinking during the recovery. Third, structural changes (due to such factors as outsourcing) in the labour market meant that we were observing permanent job losses rather than temporary layoffs. In general, economy wide figures (unemployment statistics) and the stock market did not fully recover till the summer of 2003 (Groshen and Potter 2003; NBER 2003b; Wikipedia). In the context of our empirical analysis we generate forecasts for 2001 to 2003 (period of recession) and 2004~2005 (period of recovery) [3] based on sample data from 2000~2002 and 2003~2004 respectively. A total of 1,954 firm-year observations of our sample come from 2000-2002 and 1,239 firm-year observations from 2003~2004.

### 3.2 Explanatory Variables

Given the nature of our hypotheses, we identify firms in terms of their approach to IT innovation as Systematic, opportunistic, and non-IT innovators. Following a similar yet more conservative approach than Stratopoulos and Lim (2007); we create four-year rolling windows (i.e., 1997-2000, 1998-2001, … 2001-2004), and within each one of these windows, we classify a firm as a systematic innovator (SYS=1) if they have been recognized in *IW500* more than three consecutive times in the four-year rolling window ending with current year.[4] Non IT-innovators are firms that have not been recognized in any

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argue has driven this perception: the telecommunications deregulation in 1996, the Y2K problem, the dot com boom, the crash of NASDAQ, and 9/11.

[3] The recovery period continued till the fall of 2007. We limit our analysis to the years 2004 and 2005 because we use the same sample data set of IT innovators as in Stratopoulos and Lim (2007) and this data set ends in 2004.

[4] We classify a firm as a *systematic* IT innovator if it has appeared in the list of *IW500* in more than two consecutive years in a four year rolling window. In other words, we replicated our empirical analysis using the same definition as in Stratopoulos and Lim (2007) and our results were the same.

of the four years. We classify the rest as opportunistic innovators. Opportunistic innovators are firms that have appeared sporadically in *IW500*; they have not been able to demonstrate a pattern of continuity/persistence of IT innovation in a four-year rolling window. Based on this classification, our selected sample produced the following results: 536 systematic firm-year observations (SYS=1); 1,323 opportunistic firm-year observations (OPP=1); and 1,334 non-IT innovative firm-year observations (SYS=0 and OPP=0).

### 3.3 Measures of Firm Performance

Following Cheng (2005) and Hawawini et al. (2002), we measure firm performance, firm abnormal ROE (ROEA), which equals residual income scaled by book value of equity. Prior research suggests that a firm's value is determined by current book value and the present value of expected future residual income, where residual income is the difference between actual income and expected income determined by a firm's market required cost of equity (Ohlson, 1995).
Following Cheng (2005), we derive the industry cost of equity from the 48 industry risk premiums documented by Fama and French (1997, table 6, page 172~173). The industry cost of equity is the sum of the annualized one-month T-bill yield and the Fama and French (1997) industry equity premium. The industry equity premium is estimated from the three-factor model as studied in Fama and French (1997). Firms in a same industry shares the same industry cost of capital in the calculation of abnormal ROE. To distinguish differential firm abnormal ROE beyond industry average abnormal ROE, we compute the industry average abnormal ROE weighted by book value of equity (ROEAIN) and then take the difference between firm abnormal ROE and industry average ROE for firm differential abnormal ROE (ROEFM).

We predict that for systematic IT innovative firms, their current positive abnormal ROE is persistent, yet their current negative abnormal ROE is transitory. We define an indicator variable (GN) to distinguish positive abnormal ROE (GN=1 if ROEA>0) from negative abnormal ROE (GN=0 if ROEA<=0). We also expect systematic IT innovative firms will be more likely to recover from losses during recession years (RECESS=1), and more likely to maintain their good performance in recovery periods (RECESS=0).

### 3.4 Control Variables

Based upon recent studies of the determinants of IT investments, we control for the effects of known firm-characteristics that are associated with firm performance. Previous studies (Lev, 1983; Cheng 2005) find that large firms are more likely to have persistent good financial performance relative to small firms and they attribute this to the competitive advantage of large firms. We measure firm size (SIZE) as the natural log of total assets.

Second, research and development intensity is viewed as a proxy for a firm's intangible capital, which may enhance firm performance (Li and Wong 2005). We measure R&D (RND) as a firm's R&D expenditures divided by sales Callen et al. 2005; Darrough and Rangan 2005; Bharadwaj et al. 1999; Hitt and Brynjolfsson, 1996. Prior studies (Asthana and Zhang 2006) have found that firms' and industries' R&D intensities are both positively correlated with persistence of abnormal earnings.

Following prior studies, we also include market share (MS) in our analysis, where MS is defined as the ratio of a firm's sales to the total industry sale. The literature shows mixed findings regarding both the sign and the statistical significance of the market share-firm performance relationship (Szymanski et al. 1993). This may be because of the inclusion of some proxy variables for power, which may weaken the statistical association between market share and firm performance (e.g., Hitt and Brynjolfsson 1996). In addition, firms with high market shares may derive no extra negotiation power benefits, and as a result, the efforts devoted to increasing market share (e.g., marketing costs and capacity build-up) may not pay off (e.g., Szymanski et al. 1993). Hence, we cannot predict the sign of market share (MS).

Following Cheng (2005), we compute the industry concentration ratio (CR) for each industry formed by 2-digit SIC codes, which equals the squared market shared in an industry. Cohen and Levin (1989) find that industry concentration is conversely related to industry competitiveness (Cohen and Levin 1989). However, Cheng (2005) argues that a high industry concentration represents high barriers to entry and can induce and sustain economic rents by reducing threats from outside competition. Thus, we do not have predicted sign for the industry concentration variable (CR).

### 3.5 Research Model

Prior research suggested that the coefficient $\alpha_1$ should be positive in the first-order autoregressive (AR) model, meaning that the accounting income of two adjacent fiscal years should be positively correlated (e.g. Lev, 1983, and Kormendi and Lipe, 1987). Thus next period abnormal ROE is a function of current abnormal ROE:

$$ROEA_{t+1} = \phi_0 + \alpha_1 * ROEA_t + \varepsilon_t \quad \textbf{(1)}$$

where *ROEA* is the abnormal ROE, *t* is year subscript. For abbreviation, firm subscript is omitted from all equations. The coefficient $\alpha_1$ captures the persistence of current abnormal ROE.

Following Cheng (2005), we decompose current abnormal ROE into industry average abnormal ROE ($ROEAIN_{j,t}$), and firm differential ROE ($ROEAFM_t$):

$$ROEA_t = ROEAIN_{j,t} + ROEAFM_t \quad \textbf{(2)}$$

where *j* stands for the industry to which each firm belongs. Because industry abnormal ROE varies with industry characteristics and firm differential ROE varies with firm characteristics, these two components might have different persistence (Cheng 2005). Our research focus is the persistence of firm specific ROE. Therefore, the isolation of firm differential ROE from industry average ROE introduces control on industry specific abnormal ROE and enables our tests to address how the IT innovation strategy of each firm affects their abnormal ROE performance at the firm level.

From equation 2 and equation 1, we can derive equation 3 as follows:

$$ROEA_{t+1} = \phi_0 + \alpha_0 ROEAIN_{j,t} + \alpha_1 * ROEAFM_t + \varepsilon_t \quad \textbf{(3)}$$

where *ROEAIN* is industry abnormal ROE, computed as weighted (by book value) average firm abnormal ROE within a same industry formed by two-digit SIC codes, *ROEAFM* is firm abnormal ROE computed as the difference between *ROEA* and *ROEAIN, j* is industry subscript. Following Cheng (2005), we allow different coefficients for industry ROE ($\alpha_0$) and for firm ROE ($\alpha_1$) to reflect their different persistence. We expect both $\alpha_0$ and $\alpha_1$ positive based on the findings of Cheng (2005).

To test our first hypothesis, we add systematic and opportunistic IT innovative variable ($SYS_t$, and $OPP_t$) in the regression to test if firms that systematically innovate with IT outperform opportunistic and non-IT innovative firms:

$$\begin{aligned} ROEA_{t+1} &= \phi_0 + \alpha_0 ROEAIN_{j,t} + \alpha_1 * ROEAFM_t + \alpha_2 * SYS_t + \alpha_3 OPP_t \\ &+ \gamma_1 * SIZE_t + \gamma_2 * RND_t + \gamma_3 * MS_t + \gamma_4 * CR_t + \zeta_t \end{aligned} \quad (4)$$

where $SYS_t$ equals one if a firm has been classified as systematic IT innovator in the four year window (including current year *t*), and zero otherwise; $OPP_t$ equals one if the firm has been classified as opportunistic IT innovator in the four year window (including current year *t*), and zero otherwise. Our control variables include *SIZE*, the natural logarithm of total assets; *RND*, the percentage of R&D investment over sales; *MS,* the market share, equals the percentage of a firm's sale over the total sales of an industry formed by two-digit SIC code; *CR*, industry concentration ratio (Herfindahl index), equals the sum of squared market shared in the industry.

Our first hypothesis predicts that the abnormal ROE of systematic IT innovative firms is higher relative to opportunistic and non-IT innovative firms. So the expected sign of the coefficient $\alpha_2$ of the variable $SYS_t$ is positive. While we do not have prediction of the coefficient $\alpha_3$ of the variable $OPP_t$, we expect the coefficient $\alpha_2 > \alpha_3$.

Our second hypothesis (2a and 2b) predicts different persistence of the abnormal ROE of systematic IT innovative firms relative to opportunistic and non-IT innovative firms, conditioning on good/bad news and recession/recovery period. Therefore, we introduce the two-way interaction terms of firm abnormal ROE ($ROEAFM_t$) with indicator variable $SYS_t$ and $OPP_t$, as well as with our control variables:

$$\begin{aligned} ROEA_{t+1} &= \phi_0 + \alpha_0 ROEAIN_{j,t} + \alpha_1 * ROEAFM_t + \alpha_2 * SYS_t + \alpha_3 * OPP_t \\ &+ \alpha_4 * ROEAFM_t * SYS_t + \alpha_5 * ROEAFM_t * OPP_t \\ &+ \gamma_1 * SIZE_t + \gamma_2 * RND_t + \gamma_3 * MS_t + \gamma_4 * CR_t + \gamma_5 * ROEAFM_t * SIZE_t \\ &+ \gamma_6 * ROEAFM_t * RND_t + \gamma_7 * ROEAFM_t * MS_t + \gamma_8 * ROEAFM_t * CR_t + \xi_t \end{aligned} \quad (5)$$

Hypothesis two (2a and 2b) requires regressions by good (GN=1) and bad (GN=0) news subsamples, which are formed by the sign of $ROEAFM_t$ (GN=1 if $ROEAFM_t>0$, otherwise GN=0). For good news observations, hypothesis 2.a predict $\alpha_4 > 0$ and $\alpha_4 > \alpha_5$. This means that systematic IT innovative firms are more likely to continue their current good performance in the next year (have more persistent good performance) relative to opportunistic and non-IT innovative firms. For bad news observations, hypothesis 2.b predict that $\alpha_4 < 0$ and $\alpha_4 < \alpha_5$. This means that systematic IT innovative firms are more likely to turn around their current bad performance in the next year (have more transitory bad performance) relative to opportunistic or non-IT innovative firms.

Note that while according to hypothesis one, the abnormal ROE of systematic IT innovative firms is higher relative to opportunistic IT innovative firms and non-IT innovative firms, i.e., $\alpha_2 > 0$, and $\alpha_2 > \alpha_3$. However, when grouping firms by their current abnormal ROE performance, the good performance of systematic IT innovative firms relative to opportunistic or non-IT innovative firms is partially captured by the intercept $\phi_0$ . Specifically, the coefficient estimate of $\phi_0$ in the regression of good news sample is greater than the $\phi_0$ in the regression of the bad news sample. In other words, the effect of variable $SYS_t$ on $ROEA_{t+1}$ is partly subsumed by the good and bad news sample split. Therefore, we may not observe the prediction of hypothesis one ($\alpha_2 > 0$, and $\alpha_2 > \alpha_3$) in the good/bad news regression.

Hypothesis 3a predicts that for the recession period (RECESS=1), the coefficient $\alpha_4 < 0$, and $\alpha_4 < \alpha_5$. This means that systematic IT innovative firms are more likely to recover from the recession in the next year (have more transitory abnormal ROE) relative to opportunistic or non IT innovative firms. Hypothesis 3b predicts that for recovery period (RECESS=0), the coefficient $\alpha_4 > 0$, and $\alpha_4 > \alpha_5$. This means that systematic IT innovative firms are more likely to continue their good performance in the recovery period in the next year (have more persistent abnormal ROE) relative to opportunistic or non IT innovative firms.

## DISCUSSION OF RESULTS

Descriptive statistics for all variables are shown Panel A of Table 2. The current abnormal ROE ($ROEA_t$) has a mean of 0.02, which is greater than the close-to-zero mean of one-year ahead abnormal ROE ($ROEA_{t+1}$). However, their median values are the same (0.03). The industry abnormal ROE ($ROEAIN_t$) has a mean of 0.03 and the differential firm abnormal ROE ($ROEAFM_t$) has a mean of -0.02. The mean systematic IT innovation variable ($SYS_t$) is 0.17, indicating that 17 percent of our sample is categorized as systematic IT innovators in the period 2000~2004. The indicator variable of opportunistic IT innovators ($OPP_t$) has a mean of 0.41, meaning that 41% of our sample is categorized as opportunistic IT innovators in the period 2000-2004. The good news indicator (GN) has a mean of 0.64, suggesting that 64 percent of our observations have positive current abnormal ROE. The recession indicator (*RECESS*) has a mean of 0.61, presenting that 61 percent of our sample falls into the recession period. The distribution of all control variables size (SIZE), R&D (RND), market share (MS), and industry concentration ratio (CR) have no obvious outliers. Our examination of the standard errors and size of the coefficients also shows that they are not sensitive to the inclusion or exclusion of the highly correlated variables, indicating multicollinearity is unlikely to be problematic (Hosmer and Lemeshow 1989).

[Insert Table 2]

Panel B of Table 2 presents the correlation coefficients for all variables in the multivariate model. While market share (*MS*) and industry concentration (*CR*) are highly correlated with a correlation coefficient of 0.71, none of the correlations between the control variables and our key testing variables (the abnormal ROE variables $ROEA_t$ and $ROEA_{t+1}$, the good news indicator GN, and the recession indicator RECESS) are above 0.20, and the highest variance inflation factor (VIF) in our regression is 7.87. To facilitate the interpretation of our coefficients, we take the difference between each control variable (SIZE, RND, MS, CR) and its corresponding mean value . So the coefficient of variable $ROEA_t$ captures the sample average persistence of abnormal ROE.

### 4.1 Univariate Analysis

To provide preliminary evidence on our proposed hypotheses, we first calculate average abnormal *ROE* for the current *t* and next period *t+1*. If systematic IT innovative firms outperform than non-systematic IT innovative firms (including both the opportunistic and non IT innovators), the average abnormal *ROE* of systematic IT innovative firms should be higher compared to non-systematic IT innovative firms. Consistent with our prediction, Panel A of Table 3 shows that systematic IT innovative firms have greater abnormal ROE in both current period *t* and next period *t+1*, for not only the full sample but also subsamples partitioned by good/bad news and recession/recovery periods. All differences are statistically significant at less than 5 percent level except for the difference in current ROE of the good news subsample. This loss of significance for the good news subsample is likely to be because the good news partition is based on current abnormal ROE, thus it subsumes the positive effect of systematic IT innovation on current abnormal ROE.

[Insert Table 3]

We also conduct frequency analysis to reveal how systematic IT innovation affects the autocorrelation between current and future abnormal ROE. Specifically, this analysis addresses our research question whether it is more likely for systematic IT innovative firms to continue their current good performance in the future, or alternatively, to revert their current bad performance in the future. If a firm has two consecutive positive (negative) abnormal ROE in year *t* and *t+1*, it is categorized as the 'consistent' group; otherwise it is categorized as the 'inconsistent' group. Since these results are descriptive in nature and do not account for control variables, they only provide preliminary evidence on the relative performance of systematic IT innovators versus non-systematic IT innovators.

The Panel B of Table 3 shows that for our full sample, more systematic IT innovative firms (81%) have consistent abnormal ROE relative to the non-systematic IT innovative firms (78%). When grouping observations by good/bad news or recession/recovery periods, we find that systematic IT innovative firms having good news or in the recovery period are more likely to have a persistent abnormal ROE of same signs in two consecutive years. And the Chi-square statistics both the good news (4.97) and recovery (3.59) subsamples are significant at 3 and 6 percent level respectively. In contrast, while Chi-square statistics are insignificant, systematic IT innovative firms experiencing bad news or in the recession period appear to more likely have non-persistent abnormal ROE of different signs in two consecutive years.
In summary, our univariate result indicates that systematic IT innovative firms are more likely to maintain their current good abnormal ROE performance (in recovery period) and flip their current bad abnormal ROE performance (in recession period).

### 4.2 Regression Results: Hypothesis One

We first run a regression of equation 3 as our base model and find that the one-year ahead abnormal ROE ($ROEA_{t+1}$) is positively related to both current industry abnormal ROE ($ROEAIN_t$) and current firm differential abnormal ROE ($ROEAFM_t$). Table 4 report the regression statistics, the variable $ROEAIN_t$ has a coefficient of 0.85 and the variable $ROEAFM_t$ has a coefficient of 0.52, all significant at less than 1% level and comparable to the coefficient reported in Cheng (2005, Table 3, page 98).

[Insert Table 4]

We then add the systematic IT innovation indicator variable ($SYS_t$) and the opportunistic IT innovation indicator variable ($OPP_t$) in the regression to test our hypothesis one. Consistent with our predictions, we find a significant positive association between $ROEA_{t+1}$ and $SYS_t$ for both regressions that with and without control variables (coefficient = 0.03, t-stat = 2.34), and the coefficient of $SYS_t$ is more positive than the coefficient of $OPP_t$ ($\alpha_2 - \alpha_3$ =0.04, t-stat=12.07). These findings suggest that systematic IT innovators have higher abnormal ROE than opportunistic and non-IT innovators. We also find that the high R&D firms are associated with significantly lower abnormal ROE relative to low R&D firms as indicated by the negative coefficient of $RND_t$ (coefficient = -0.10, t-stat = -4.02). The other control variables of size (SIZE), market share (MS) and industry concentration ratio (CR) are all insignificant.

### 4.3 Regression Results: Hypothesis Two—Good News versus Bad News

Our hypothesis two predict that the persistence of abnormal ROE for systematic IT innovative firms depends on the level of current abnormal ROE: if current abnormal ROE is positive (good news), it is more likely to sustain in the next period; if current abnormal ROE is negative (bad news), it is more likely to be transitory and evaporate in the next period. Therefore, to test our hypothesis two, we estimate equation 5 by good and bad news partition of our sample.

However, before splitting sample by good and bad news, with our full sample, we find that the coefficient of $SYS_t$ is significantly positive (coefficient = 0.03, t-stat = 2.46) and greater than the coefficient of $OPP_t$ ($\alpha_2 - \alpha_3$ =0.04, t-stat=12.58). This means that our hypothesis one still holds after including all the interaction terms between $ROEAFM_t$ and our independent variables $SYS_t$ and $OPP_t$, and our four control variables. The coefficient of the interaction term $ROEAFM_t*SYS_t$ is insignificantly different from zero (t-stat = -0.67), meaning that before conditioning on the good/bad news and recession/recovery, the overall persistence of firm abnormal ROE for the systematic IT innovators is insignificantly different from that of the non-IT innovators. However, the coefficient of the interaction term $ROEAFM_t*OPP_t$ is significantly negative (coefficient = -0.13, t-stat = -2.88), suggesting that before conditioning on the good/bad news, the overall persistence of firm abnormal ROE for the opportunistic IT innovators is significantly lower than that of the non-IT innovators. Consequently, the overall persistence of firm abnormal ROE of the systematic IT innovators is significantly higher than that of the opportunistic IT innovators ($\alpha_4 - \alpha_5$ = 0.09, t=2.06).

[Insert Table 5]

After splitting the sample by good and bad news, consistent with our hypothesis two (2a and 2b), we find that the coefficient of the interaction term $ROEAFM_t*SYS_t$ is significantly positive for the good news subsample (coefficient = 0.14, t-stat = 2.43), but negative for the bad news subsample (coefficient = -0.35, t-stat = -2.22). This means that systematic IT innovators exhibit more persistence good performance (positive abnormal ROE) and more transitory bad performance (negative abnormal ROE) relative to non-IT innovators. In the bad news sample regression, we also find evidence that when systematic IT innovators are confronted with a bad performance in the current year, they are more likely to turnaround and achieve better performance than the opportunistic IT innovators ($\alpha_4 - \alpha_5$ = -0.20, t=1.59). However, we did not find significant evidence (in the good news sample regression) that systematic IT innovators have more persistent good performance relative to opportunistic IT innovators ($\alpha_4$ - $\alpha_5$ = 0.01, t=0.01).

### 4.4 Regression Results: Hypothesis Three—Economic Cycle Effect

Our hypothesis three (3a and 3b) predict that systematic IT innovators have persistent abnormal ROE in the recovery period and less persistent abnormal ROE in the recession period, thus we estimate equation 5 by the recession and recovery period partition. Consistent with our prediction, we find that the coefficient of the interaction term $ROEAFM_t*SYS_t$ is significantly positive for the recovery subperiod (coefficient = 0.14, t-stat = 2.74), but negative for the recession subperiod (coefficient = -0.20, t-stat = -2.03). This means that systematic IT innovators have more persistent (transitory) abnormal ROE relative to non-IT innovators in recovery (recession) period. In the recovery period regression, we also find evidence that systematic IT innovators are more likely to have more persistent abnormal ROE than opportunistic IT innovators ($\alpha_4$ - $\alpha_5$ = 0.16, t=8.03). However, we did not find significant evidence (in the recession period regression) that systematic IT innovators have more transitory abnormal ROE relative to opportunistic IT innovators ($\alpha_4$ - $\alpha_5$ = -0.07, t=0.49).

To test the joint effect of good/bad news and recovery/recession on the persistence of abnormal ROE of systematic IT innovators, we conduct further analysis and estimate equation 5 by four subsamples, namely, good news observations in recession period, and bad news observations in recession period, good news observations in recovery period, and bad news observations in recovery period. The results of Table 6 reveal that the transitory abnormal ROE associated with systematic IT innovators in the recession period, is mainly for the bad news firms. The coefficient estimate of the interaction term $ROEAFM_t*SYS_t$ for the recession and bad news subsample is -0.41 (t-stat = -2.09) and the difference between the coefficient estimate $ROEAFM_t*SYS_t$ and $ROEAFM_t*OPP_t$ is -0.36 (t-stat = 3.65). We find no significant evidence that the systematic IT innovators have more persistent abnormal ROE relative to opportunistic and non-IT innovators in the subsample of recession and good news.

[Insert Table 6]

On the other hand, the regression of the good news and recovery period subsample seems perplexing. Although systematic IT innovators show more persistent abnormal ROE than non-IT innovators ($\alpha_4$ =0.19, t-stat = 3.69), opposite to our prediction, we find that systematic IT innovators have less persistent abnormal ROE relative to opportunistic IT innovators ($\alpha_4$ - $\alpha_5$ = -0.18, t=8.32). However, these results make sense for the following two reasons: 1. While the recovery period extends till the fall of 2007, our forecast period covers only the first two years of recovery (2004-2005). We limited our analysis to the years 2004-2005 because we use the same sample data set of IT innovators as in Stratopoulos and Lim (2007) and this data set ends in 2004. 2. In absolute levels, the systematic IT innovators significantly outperform the opportunistic IT innovators by 2% in firm differential abnormal ROE in the good news recovery sample (SYS - OPP = 0.02, t = 3.6). Since it is more difficult to maintain high growth in abnormal ROE because competition will drive away high abnormal ROE (Cheng, 2005), this may contribute to lower persistence of the abnormal ROE of systematic IT innovators relative to that of the opportunistic IT innovators.

Collectively, our findings largely support our three hypotheses, suggesting that systematic IT innovators have higher abnormal ROE, and more persistence (transitory) good (bad) performance relative to opportunistic and non-IT innovators. Moreover, the persistence of abnormal ROE of systematic IT innovators is higher (lower) than that of opportunistic and non-IT innovators in more regular recovery period (chaotic recession period).

## SUMMARY AND CONCLUSION

### 5.1 Summary & Implications

Overall, our findings suggest that systematic IT innovation strategy leads to value creation and this value creation resists the erosion from competitors' actions. Based on our sample of large US firms, systematic IT innovators enjoy higher abnormal ROE than opportunistic and non-IT innovators, and overall persistence of firm abnormal ROE of the systematic IT innovators is significantly higher than that of the opportunistic IT innovators. During a recession, when systematic IT innovators are confronted with a bad performance in the current year, they are more likely to turnaround and achieve better performance than opportunistic IT innovators.

Based on the evidence from the recession of the early 2000s, we conclude that companies that had adopted a systematic approach to IT innovation have demonstrated remarkable business agility. They are better prepared to deal with economic recessions and the turbulence of a modern hypercompetitive environment. Our findings complement prior evidence that has shown that successful companies tend to *press their advantage* (invest) during recession as a preparation for recovery (Dobbs et al. 2002).

The study has several implications. First, we have introduced a new economic characteristic (IT innovation strategy) in the literature of drivers of earnings persistence. Analysts and investors interested in selecting companies with long-term potential (earnings persistence) may want to consider the company's IT innovation strategy in their evaluation. Second, we evaluated the role of IT innovation strategy during the recent business cycle, as well as in the context of good news and bad news. This prepares a path for more future research on the role of IT innovation strategies in the context of the current global economic crisis. Third, although the results indicate that systematic IT innovation leads to improved firm earning persistence, the underlying mechanisms for developing a successful systematic IT innovation strategy require further investigation. Fourth, with budget cuts on center stage of IT agendas, forward looking managers are exploring ways to use IT in order to cut costs in a way that will help them leap ahead of weakened competitors (Kaplan, Roberts, and Sikes 2008; Kaplan and Sikes 2008; McGee and Soats 2008). To these managers, the message of our study is that a long-term systematic approach to IT innovation is better than trying to follow the most recent technological trend or new killer application.

### 5.2 Limitations

Our main source, *IW500* does not provide the complete list of firms that were considered as IT innovative but which were subsequently rejected. In other words, we have access to a truncated sample of only the firms that have attained IT innovation status.[5] As mentioned in the description of the data set, we tried to mitigate this limitation by leveraging IS and management literature as well as the guidelines followed by *IW500*. We looked at the top competitors and we used the same source (*Hoover's*) that was used by *IW500* for the compilation of their data set. We limited the number of competitors to a maximum of three in order to ensure that only companies that could have been included in the *IW500* pool of candidates were included in our control group.

Another limitation that warrants mention is the selection of the control groups. We use top three competitors from *Hoover's,* which was actively involved in the completion of *IW500*. Despite attempts to match the control sample based on industry type and firm size, for some of firms in IT innovative sample, an appropriate control firm of similar size, but could be also IT innovative firms in a different time period. In addition, our lack of knowledge about the IT capability of the control sample precludes any direct comparison of the two groups on the nature and quality of their IT resources.

Finally, for our analysis we have used the same sample data set period (2000-2004) as in Stratopoulos and Lim (2007) and this limits our ability to forecast in the recovery period to the years 2004 and 2005. According to the NBER the recovery period lasted until the end of 2007.

### 5.3 Future Research

Although the results indicate that IT innovation persistence leads to improve firm's earning persistence, the underlying mechanisms through which this can be achieved further. Factors such as IT intensity, current state of IT, and several new areas of IT innovation could play a critical role in determining the success of IT innovation persistence. Perceptions regarding the number of associated agents, such as customers, suppliers, or intermediates, the capabilities of their IT expertise, or the type of arrangements could also influence earning persistence. Examining such additional factors might be a fruitful research endeavour in the future.

The period of analysis offers another opportunity for future expansion of our work. Our analysis in based on the recession in the early 2000s, which was more localized in nature (mostly US) and it was driven in part by the 9/11 events. Future studies will have to replicate this with data from the current crisis which is global in nature and driven by the financial crisis.

### 5.4 Conclusion

While, IT innovation may not be suitable and feasible for all firms, companies that have developed a systematic approach to IT innovation are better prepared to deal with the modern hypercompetitive environment. Systematic IT innovation strategy leads to the creation of sustainable value creation.

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[5] This is a common limitation applying to all studies (Bharadwaj 2000; Santhanam and Hartono 2003; Stratopoulos and Lim 2007, and numerous others) that relied on the *IW500* data set.

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**Appendix 1: Variable Descriptions**

| Variables | | Definition |
|---|---|---|
| **$ROEA_{t+1}$** | DV | One-year ahead abnormal ROE |
| **$ROEA_t$** | IV | Net income $(\#237)_t$/Book value of equity $(\#60)_{t-1}$ - cost of $equity_t$* |
| **$ROEAIN_{j,t}$** | IV | Industry average abnormal ROE weighted by book value of equity. |
| **$ROEAFM_t$** | IV | Firm differentiated abnormal ROE, i.e. ROEA minus ROEAIN. |
| **$SYS_t$** | IV | 1 if a firm has a systematic IT innovation strategy; otherwise 0. |
| **$OPP_t$** | IV | 1 if a firm has an opportunistic IT innovation strategy; otherwise 0. |
| **$GN_t$** | IV | 1 if a ROEA>0 and zero otherwise |
| **$RECESS_t$** | IV | 1 for the testing period 2000~2002, and zero for 2003~2004 |
| **$SIZE_t$** | CV | Natural logarithm of total assets (#6). |
| **$RND_t$** | CV | Research & Development Expenditure: (#46) / Net Sales (#12) |
| **$MS_t$** | CV | Market share: Net Sales (#12) / ∑(Net Sales (#12) over the industry |
| **$CR_t$** | CV | Industry concentration ratio (Herfindahl index): Sum of squared market shared in the industry |
| ***t*** | | Year subscript, from 2000 to 2004. |
| ***j*** | | Industry subscript, identified by Fama and French (1997) 48 industry classification. |

*We derive the industry cost of equity derived from the 48 industry risk premiums documented by Fama and French (1997, table 6, page 172~173). The industry cost of equity is the sum of the annualized one-month T-bill yield and the Fama and French (1997) industry equity premium. The industry equity premium is estimated from the three-factor model as studied in Fama and French (1997). Firms in a same industry shares the same industry cost of equity in the calculation of firm abnormal ROE.

**Table 1: Sample Selection (1997-2004)**

| | |
|---|---|
| **Step 1: InformationWeek 500 (IW500)** | |
| Firm-records based on initial InformationWeek 500 sample from 1997-04 (Firm-Year) | 4,000 |
| Firm-records eliminated because we would not be able to produce financial data (entries associated with private, nonprofit, foreign, bankrupt, etc. firms. | (588) |
| Firm-records eliminated because parent firm appeared more than once in a year (survey was done by collecting data at the business unit level) | (17) |
| Firm-records associated with publicly traded firms | 3,395 |
| | |
| Unique firms among the firm-records (IT Innovative firms) | 1,067 |
| **Step 2: Hoover's** | |
| IT innovative firms eliminated because they were not listed in Hoover's or their top competitors did not appear in Hoover's. | (445) |
| | |
| IT innovative firms (IW500 and Hoover's) | 622 |
| Non-IT innovative direct competitors added - controlled for size (revenue) and industry structure (SIC classification). | 338 |
| **Selected Firms – 622 IT innovative and 338 non-innovative firms** | **960** |
| **Step 3: COMPUSTAT data availability** | |
| Firms eliminated because they have no COMPUSTAT matching | (26) |
| Unique firms remained in the sample<br>Number of firm-year observations for the testing period 2000~2004 (Initial three-year observations from 1997 to 1999 are required to derive the systematic IT innovation variable) | 934<br>4670 |
| Firm-year observations eliminated due to missing current and one-year ahead abnormal ROE data (2000~2004) | (1393) |
| Firm-year observations eliminated top and bottom 1% current and one-year ahead ROE and abnormal ROE data | (84) |
| Firm-year observations remained in the selected sample (2000~2004)<br><br>Systematic IT innovative firm-year observations<br>Opportunistic IT innovative firm-year observations<br>Non-IT innovative firm-year observations<br><br>Recession period innovative firm-year observations<br>Recovery period innovative firm-year observations | 3193<br><br>536<br>1334<br>1323<br><br>1954<br>1239 |
| **Final Data Set – Unique Firms (2000~2004)** | **712** |

**Table 2 Descriptive Statistics**

**Panel A: Descriptive Statistics of Variables**

| Variables | Mean | Std. | MIN | P25 | Median | P75 | MAX |
|---|---|---|---|---|---|---|---|
| $ROEA_{t+1}$ | 0.00 | 0.24 | -4.99 | -0.05 | 0.03 | 0.09 | 1.27 |
| $ROEA_t$ | 0.02 | 0.21 | -1.96 | -0.04 | 0.03 | 0.10 | 1.47 |
| $ROEAIN_{j,t}$ | 0.03 | 0.08 | -0.74 | 0.00 | 0.04 | 0.07 | 0.59 |
| $ROEAFM_t$ | -0.02 | 0.19 | -1.84 | -0.07 | 0.00 | 0.05 | 1.22 |
| $SYS_t$ | 0.17 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| $OPP_t$ | 0.41 | 0.49 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 |
| $GN_t$ | 0.64 | 0.48 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 |
| $RECESS_t$ | 0.61 | 0.49 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 |
| $SIZE_t$ | 8.83 | 1.74 | 1.03 | 7.71 | 8.70 | 9.87 | 14.23 |
| $RND_t$ | 0.02 | 0.15 | 0.00 | 0.00 | 0.00 | 0.02 | 7.55 |
| $MS_t$ | 0.12 | 0.16 | 0.00 | 0.02 | 0.06 | 0.17 | 1.00 |
| $CR_t$ | 0.16 | 0.15 | 0.01 | 0.07 | 0.11 | 0.20 | 1.00 |

The descriptive statistics on all variables are based on the full sample of 3,193 firm-year observations in the period 2000-2004. See Appendix 1 for variable measurement.

**Table 2 Descriptive Statistics (Continued)**

**Panel B: Correlations between Variables**

| | $ROEA_{t+1}$ | $ROEA_t$ | $ROEAIN_{j,t}$ | $ROEAFM_t$ | $SYS_t$ | $OPP_t$ | $GN_t$ | $RECESS_t$ | $SIZE_t$ | $RND_t$ | $MS_t$ | $CR_t$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$ROEA_{t+1}$** | 1 | | | | | | | | | | | |
| **$ROEA_t$** | 0.49 *** | 1 | | | | | | | | | | |
| **$ROEAIN_{j,t}$** | 0.29 *** | 0.39 *** | 1 | | | | | | | | | |
| **$ROEAFM_t$** | 0.41 *** | 0.92 *** | -0.01 | 1 | | | | | | | | |
| **$SYS_t$** | 0.07 *** | 0.06 | -0.02 | 0.07 *** | 1 | | | | | | | |
| **$OPP_t$** | -0.04 *** | -0.03 | 0.00 | -0.03 * | -0.38 *** | 1 | | | | | | |
| **$GN_t$** | 0.39 *** | 0.59 *** | 0.32 *** | 0.50 *** | 0.05 *** | 0.02 | 1 | | | | | |
| **$RECESS_t$** | -0.20 *** | -0.13 *** | -0.27 *** | -0.03 * | -0.09 *** | 0.10 *** | -0.17 *** | 1 | | | | |
| **$SIZE_t$** | 0.07 *** | 0.08 *** | -0.02 | 0.10 *** | 0.14 *** | 0.16 *** | 0.11 *** | -0.05 *** | 1 | | | |
| **$RND_t$** | -0.13 *** | -0.14 *** | -0.04 ** | -0.14 *** | 0.00 | 0.00 | -0.06 *** | 0.02 | -0.05 *** | 1 | | |
| **$MS_t$** | 0.06 *** | 0.07 *** | 0.01 | 0.07 *** | 0.12 *** | 0.04 ** | 0.06 *** | -0.01 | 0.12 *** | -0.06 *** | 1 | |
| **$CR_t$** | 0.03 | 0.03 | 0.04 ** | 0.01 | 0.05 *** | -0.02 | 0.02 | -0.03 * | -0.11 *** | -0.05 *** | 0.71 *** | 1 |

*** <1% significant level; ** <5% significant level; * <10% significant level

The correlation triangle reports Spearman correlations between variables using a full sample of 3,193 firm-year observations in the period 2000-2004. See Appendix 1 for variable measurement.

**Table 3: Two by Two Mean and Frequency Analysis**

| | All Firm-Years | | Good News Firm-Years | | Bad News Firm-Years | | Recession Firm-Years | | Recovery Firm-Years | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Panel A: Mean Analysis*** | | | | | | | | | | |
| **Mean** | $ROEA_t$ | $ROEA_{t+1}$ | $ROEA_t$ | $ROEA_{t+1}$ | $ROEA_t$ | $ROEA_{t+1}$ | $ROEA_t$ | $ROEA_{t+1}$ | $ROEA_t$ | $ROEA_{t+1}$ |
| Sys=0 | 0.01 | 0.00 | 0.11 | 0.07 | -0.15 | -0.13 | -0.01 | -0.04 | 0.05 | 0.06 |
| Sys=1 | 0.05 | 0.04 | 0.12 | 0.09 | -0.11 | -0.06 | 0.02 | 0.00 | 0.08 | 0.08 |
| Sys=1 minus Sys=0 | 0.03 | 0.05 | 0.01 | 0.02 | 0.04 | 0.07 | 0.02 | 0.05 | 0.03 | 0.03 |
| t-stat | 3.46 | 5.24 | 0.68 | 2.16 | 2.5 | 4.17 | 1.93 | 3.75 | 2.05 | 2.09 |
| p-value | 0.0006 | 0.05 | 0.497 | 0.0314 | 0.0128 | <.0001 | 0.0541 | 0.0002 | 0.0412 | 0.0369 |
| ***Panel B: Frequency Analysis*** | | | | | | | | | | |
| **Frequency** | Consistent | In-consistent | Consistent | In-consistent | Consistent | In-consistent | Consistent | In-consistent | Consistent | In-consistent |
| Sys=0: No. of Obs. | 2082 | 575 | 1334 | 326 | 748 | 249 | 1275 | 401 | 807 | 174 |
| % of Row Obs. | 78.36% | 21.64% | 80.36% | 19.64% | 75.03% | 24.97% | 76.07% | 23.93% | 82.26% | 17.74% |
| Sys=1: No. of Obs. | 434 | 102 | 315 | 54 | 119 | 48 | 209 | 69 | 225 | 33 |
| % of Row Obs. | 80.97% | 19.03% | 85.37% | 14.63% | 71.26% | 28.74% | 75.18% | 24.82% | 87.21% | 12.79% |
| Chisq. | 1.82 | | 4.97 | | 1.07 | | 0.10 | | 3.59 | |
| Prob. | 0.18 | | 0.03 | | 0.3013 | | 0.7467 | | 0.0581 | |

**Table 4 Regression Analysis: Hypothesis 1**

| | | Pred. Sign | Equation 3 | | Equation 4 (No Controls) | | Equation 4 (With Controls) | |
|---|---|---|---|---|---|---|---|---|
| | | | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| **Intercept** | | | -0.02*** | -4.5 | -0.02*** | -3.35 | -0.02*** | -2.92 |
| **ROEAIN** | | + | 0.85*** | 18.95 | 0.86*** | 19.03 | 0.85*** | 18.94 |
| **ROEAFM** | | + | 0.52*** | 26.65 | 0.51*** | 26.4 | 0.50*** | 25.28 |
| **SYS** | **H1** | + | | | 0.03*** | 2.66 | 0.03** | 2.34 |
| **OPP** | | **?** | | | -0.01 | -0.93 | -0.01 | -1.45 |
| **SIZE** | | **CV** | | | | | 0.00 | 1.53 |
| **MS** | | **CV** | | | | | 0.04 | 1.18 |
| **CR** | | **CV** | | | | | -0.03 | -0.72 |
| **RND** | | **CV** | | | | | -0.10*** | -4.02 |
| | | | | | | | | |
| **Coefficient test (one-tail):** | | | | | | | | |
| **SYS-OPP=0** | **H1** | + | | | 0.04*** | 11.25 | 0.04*** | 12.07 |
| **Adj. R2 (%)** | | | 24.85 | | 25.07 | | 25.49 | |
| **Obs.** | | | 3193 | | 3193 | | 3193 | |

*** <1% significant level; ** <5% significant level; * <10% significant level. All significant levels are based on two-tail tests except for the tests noted otherwise as one-tail.

**Table 5 Regression Analysis: Hypothesis two (external news) and three (economic cycles)**

| | | Pred. Sign | Equation 5 (All obs.) | | Equation 5 (Good news) | | Equation 5 (Bad news) | | Equation 5 (Recession) | | Equation 5 (Recovery) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat | Coeff. | t-stat |
| **intercept** | | | -0.02*** | -3.57 | -0.01* | -1.73 | -0.07*** | -4.18 | -0.04*** | -4.49 | 0.02*** | 2.55 |
| **ROEAIN** | | + | 0.89*** | 19.74 | 0.95*** | 23.78 | 0.54*** | 4.84 | 0.82*** | 12.45 | 0.75*** | 15.3 |
| **ROEAFM** | | + | 0.56*** | 16.13 | 0.59*** | 16.01 | 0.34*** | 4.34 | 0.54*** | 10.36 | 0.58*** | 17.24 |
| **SYS** | **H1** | + | 0.03*** | 2.46 | 0.00 | 0.26 | 0.01 | 0.34 | 0.03* | 1.73 | 0.01 | 0.9 |
| **ROEAFM*SYS** | **H2/3** | +/- | -0.04 | -0.67 | 0.14** | 2.43 | -0.35** | -2.22 | -0.20** | -2.03 | 0.14*** | 2.74 |
| **OPP** | | ? | -0.01 | -1.38 | -0.02*** | -2.77 | -0.04* | -1.92 | -0.02 | -1.32 | 0.01 | 0.66 |
| **ROEAFM*OPP** | | ? | -0.13*** | -2.88 | 0.13** | 2.43 | -0.16* | -1.73 | -0.13** | -2.13 | -0.01 | -0.3 |
| **SIZE** | | **CV** | 0.00 | 1.21 | 0.00 | 0.83 | 0.00 | 0.48 | 0.00 | 1.41 | 0.00 | -0.32 |
| **ROEAFM*SIZE** | | | -0.02 | -1.43 | -0.01 | -0.56 | -0.03 | -1.21 | -0.02 | -1.05 | -0.01 | -0.82 |
| **MS** | | **CV** | 0.03 | 0.98 | 0.01 | 0.49 | -0.09 | -0.98 | 0.06 | 1.14 | -0.01 | -0.39 |
| **ROEAFM*MS** | | | 0.39** | 2.11 | 0.65*** | 2.94 | -0.47 | -1.16 | 0.03 | 0.13 | 1.24*** | 6.44 |
| **CR** | | **CV** | -0.04 | -0.95 | -0.03 | -0.8 | 0.05 | 0.53 | -0.04 | -0.67 | 0.01 | 0.15 |
| **ROEAFM*CR** | | | -0.11 | -0.57 | -0.27 | -0.93 | 0.14 | 0.39 | -0.33 | -1.15 | 0.47** | 2.37 |
| **RND** | | **CV** | -0.45*** | -6.92 | -0.12 | -1.56 | -0.63*** | -5.36 | -0.63*** | -7.17 | 0.03 | 0.41 |
| **ROEAFM*RND** | | | -0.52*** | -5.88 | -0.10 | -0.15 | -0.70*** | -4.56 | -0.74*** | -6.4 | 0.26 | 0.87 |
| **Coefficients Test (one-tail):** | | | | | | | | | | | | |
| **SYS-OPP=0** | **H1** | + | 0.04*** | 12.58 | 0.02*** | 5.95 | 0.05** | 2.85 | 0.05*** | 7.51 | 0.00 | 0.1 |
| **ROEAFM*SYS -ROEAFM*OPP=0** | **H2/3** | +/- | 0.09* | 2.06 | 0.01 | 0.01 | -0.20* | 1.59 | -0.07 | 0.49 | 0.16*** | 8.03 |
| **Adj. R2 (%)** | | | 26.54 | | 35.39 | | 8.84 | | 21.12 | | 47.12 | |
| **Obs.** | | | 3139 | | 2029 | | 1164 | | 1954 | | 1239 | |

*** <1% significant level; ** <5% significant level; * <10% significant level. All significant levels in tables of this paper are based on two-tail tests except for the tests noted otherwise as one-tail.

**Table 6 Regression Analysis: Hypothesis two (external news) and three (economic cycles) combined**

| | | Pred. Sign | Equation 5 (Recession and Good news) | | Equation 5 (Recession and Bad news) | | Equation 5 (Recovery and Good news) | | Equation 5 (Recovery and Bad news) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** | **Coeff.** | **t-stat** |
| **intercept** | | | -0.04*** | -3.99 | -0.10*** | -4.85 | 0.02*** | 3.16 | 0.02 | 0.88 |
| **ROEAIN** | | + | 0.96*** | 15.29 | 0.41*** | 2.87 | 0.85*** | 19.51 | 0.45*** | 2.89 |
| **ROEAFM** | | + | 0.78*** | 11.81 | 0.22** | 2.28 | 0.47*** | 13.69 | 0.58*** | 5.51 |
| **SYS** | **H1** | + | -0.01 | -0.54 | 0.02 | 0.51 | 0.01 | 0.98 | -0.02 | -0.56 |
| **ROEAFM*SYS** | **H2/3** | +/- | 0.06 | 0.50 | -0.41* | -2.09 | 0.19*** | 3.69 | 0.00 | 0 |
| **OPP** | | ? | -0.02 | -1.45 | -0.03 | -1.06 | -0.01 | -1.15 | -0.05 | -1.52 |
| **ROEAFM*OPP** | | ? | -0.08 | -0.91 | -0.04 | -0.38 | 0.37*** | 6.34 | -0.20 | -1.51 |
| **SIZE** | | **CV** | 0.00 | -0.10 | 0.01 | 1.13 | 0.00 | 0.49 | -0.02*** | -2.46 |
| **ROEAFM*SIZE** | | | 0.03 | 1.13 | -0.03 | -1.05 | -0.04*** | -2.64 | -0.13*** | -2.6 |
| **MS** | | **CV** | 0.02 | 0.34 | -0.16 | -1.33 | 0.02 | 0.9 | 0.40*** | 2.89 |
| **ROEAFM*MS** | | | 0.73* | 1.82 | -1.28*** | -2.58 | 0.38* | 1.73 | 3.97*** | 6.2 |
| **CR** | | **CV** | -0.01 | -0.22 | 0.09 | 0.7 | -0.04 | -1.34 | -0.02 | -0.16 |
| **ROEAFM*CR** | | | -0.59 | -1.08 | 0.09 | 0.2 | 0.41 | 1.42 | -0.14 | -0.28 |
| **RND** | | **CV** | -0.34*** | -2.71 | -0.73*** | -5.33 | 0.03 | 0.35 | 0.23 | 0.99 |
| **ROEAFM*RND** | | | 0.68 | 0.71 | -0.83*** | -4.63 | -1.31* | -1.76 | 1.11* | 1.77 |
| | | | | | | | | | | |
| **Coefficients Test (one-tail):** | | | | | | | | | | |
| **SYS-OPP=0** | **H1** | + | 0.01 | 0.24 | 0.05 | 1.52 | 0.02** | 3.6 | 0.02 | 0.39 |
| **ROEAFM*SYS -ROEAFM*OPP=0** | **H2/3** | +/- | 0.14 | 1.36 | -0.36** | 3.65 | -0.18*** | 8.32 | 0.20 | 0.81 |
| **Adj. R2 (%)** | | | 27.96 | | 9.24 | | 54.30 | | 24.09 | |
| **Obs.** | | | 1117 | | 837 | | 912 | | 327 | |

*** <1% significant level; ** <5% significant level; * <10% significant level. All significant levels in tables of this paper are based on two-tail tests except for the tests noted otherwise as one-tail.