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Risk and Return of Information Technology Initiatives: Evidence from Electronic Commerce Announcements

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This paper takes an event study approach to jointly examine the wealth and risk effects associated with electronic commerce announcements, contributing to the emerging research on the riskiness of IT investments and the trade-off between risk and return in the information systems literature. We estimate a generalized event study model that allows for both systematic and unsystematic risk changes on data collected for electronic commerce announcements in the 1996–2002 time frame. A striking result emerging from our analysis is that wealth effects are not significant after controlling for contemporaneous risk changes. Both total and unsystematic risk show a significant postevent increase in 1998 and 2000, whereas systematic risk adjusts downward in 1996 and 2002. Put together, our results contribute to our nascent understanding of how IT initiatives affect the risk-return profile of the firm.

Key words: IT risk; risk and return; electronic commerce; IT event study; wealth effects; risk effects
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1. Introduction

Emerging research is starting to examine the relationship between IT risk and return (Dewan et al. 2007, Tanriverdi and Ruefli 2004), bringing the literature on IT investments closer to that on financial investments, where risk is considered the single most important determinant of return on investment (e.g., Brealey and Myers 2002). Specifically, Dewan et al. (2007) develop empirical proxies for IT risk and investigate the IT risk-return relationship using econometric analysis of secondary data. This paper deals with the same substantive issues, but takes an event study approach for jointly estimating the wealth and risk effects associated with electronic commerce announcements.

By way of background, the event study method has been fruitfully applied in the information systems literature to study the impact of general IT investments (Dos Santos et al. 1993, Im et al. 2001), IT infrastructure investments (Chatterjee et al. 2002), and CIO appointments (Chatterjee et al. 2001). Focusing on a different type of technology initiative, Subramani and Walden (2001) use the event study method to examine the value relevance of electronic commerce announcements, documenting evidence of significant positive abnormal returns in the fourth quarter of 1998. A subsequent study by Dehning et al. (2004) confirms abnormal returns in 1998, but finds negative (but insignificant) abnormal returns in the fourth quarter of 2000, suggestive of shifting investor perceptions regarding the business value of electronic commerce. Put together, the event studies in the information systems literature have generated a wealth of insights into the impact of technology initiatives on the market value of firms, and how the impact varies with firm and technology characteristics.

It is worth noting that the prior IT event study literature, as briefly summarized above, has focused exclusively on the wealth effects associated with technology initiatives. However, significant economic events might be associated with both wealth and risk effects. Indeed, when event-induced risk changes are significant, ignoring them can result in biased estimates of wealth effects (MacKinlay 1997, Boehmer et al. 1991, Kane and Unal 1988, Henderson 1990). In light of the emerging empirical evidence on the

riskiness of IT investments (Dewan et al. 2007, Hunter et al. 2003) and electronic commerce investments (Agarwal et al. 2004), it is pertinent to ask: are there significant risk effects associated with early electronic commerce initiatives, and if so, how do they affect the estimation of wealth effects? This is the central research question that motivates our research.

Innovations in the event study method have enabled the incorporation of risk effects associated with the events. These include consideration of event-induced variance changes in the estimation of abnormal returns (Boehmer et al. 1991) and flexible specifications using pre- and postevent data that allow for changes in the market model parameters themselves, as in the multivariate regression model (Binder 1985a). These developments have enabled the joint examination of risk and return in a variety of contexts, such as corporate bankruptcy (Aharony et al. 1980), banking deregulation (Aharony and Swary 1981, Binder 1985b, Allen and Wilhelm 1988), the Glass-Steagall Act (Bhargava and Fraser 1998, Yu 2002), and corporate mergers (Mandelker 1974), among others. We build on the event study methods used in this prior research for a comprehensive examination of the risk and return impacts of electronic commerce announcements.

Our empirical model incorporates a variety of features that are not normally included in standard event studies: (i) allowance for event-induced changes in both systematic and unsystematic risk components; (ii) joint estimation of wealth and risk effects; (iii) appropriate handling of event-day and industry clustering; and (iv) separate analysis of data for the years 1996, 1998, 2000, and 2002 to allow for any transient market instabilities during this period. With respect to the last point, several researchers have noted anomalous stock market behavior with respect to both stock returns (Ofek and Richardson 2003, Ljungqvist and Wilhelm 2003, and Trueman et al. 2003) and return volatility or risk (Agarwal et al. 2004, Qu et al. 2004, Lui et al. 2005) within the time frame of our study. Further, the nature and intensity of these anomalies have varied over time, peaking sometime during the 1998 to 2000 period, which some have associated with a stock market bubble. While the precise identification and systematic analysis of the bubble is beyond the scope of this paper, the elements (i)–(iv) of our flexible and generalized event study model are designed to overcome the confounding effects of any market instabilities.

In our empirical analysis, we first show that there are substantial event-induced variance changes in our data set. In light of these risk effects, we demonstrate that our flexible risk-adjusted model is statistically preferred to the standard event study model focusing on wealth effects alone. Using the generalized model, we find that wealth effects are not significant once contemporaneous risk changes are controlled for—in clear contrast with prior event studies without risk effects (Subramani and Walden 2001, Dehning et al. 2004). We find significant risk effects, which vary in their nature at different time periods in our data set. In 1998 and 2000 we find postevent increases in both total risk and the idiosyncratic (unsystematic) risk component, consistent with the findings of Agarwal et al. (2004). However, in 1996 and 2002, total and idiosyncratic risk changes are not significant, but there is a significant drop in the systematic risk component (beta). We also conduct a cross-sectional analysis to explain the variation in risk effects across firms, based on a variety of firm and event characteristics.

The structure of the rest of the paper is as follows. Section 2 provides a summary of relevant prior research. Section 3 outlines the event study methodologies, with and without risk effects that are relevant to our analysis. Section 4 describes the data and descriptive statistics, and §5 presents the empirical results. Section 6 concludes. There are three appendices, A, B, and C, which provide the mathematical details underlying our empirical specification, a complete listing of events in our data set, and sample coding of our events, respectively.

2. Relationship to Existing Literature

In this section we briefly describe three streams of research that inform our empirical examination: (i) IT investments literature; (ii) IT-related event studies; and (iii) risk effects in event studies. Our contribution is at the confluence of these streams of work, as discussed below.

2.1. IT Investments Literature

The recent empirical evidence documented in the IT investments literature provides inexplicably high estimates of IT returns. In IT productivity studies, for

example, the return on investment (ROI) of IT capital is reported to be about 80% using a production function analysis (e.g., Brynjolfsson and Hitt 1996). The estimated returns are even higher in studies examining the market value of IT investments, with IT value multiples—defined as increase in firm market value associated with one additional dollar of IT investment—estimated to be 10 to 15 in Brynjolfsson et al. (2002) and as high as 26 to 62 in the Anderson et al. (2003) study of enterprise resource planning (ERP) investments. Reacting to these findings of excess IT returns, Anderson et al. (2003) have characterized the present state of knowledge in the IT investments literature as the "new productivity paradox."

Potential explanations for this puzzle are provided by Brynjolfsson et al. (2002), Anderson et al. (2003), and Dewan et al. (2007), with the last focusing on IT risk considerations.[1] Specifically, Dewan et al. (2007) develop an empirical proxy measure for IT risk and incorporate it into production function and market value specifications, guided by options-pricing theories of investment under uncertainty. Firms characterized by high IT risk are found to have substantially higher IT output elasticity and IT marginal product, relative to low IT risk firms. The IT risk term is positive and significant in the market value specification, and its inclusion reduces the IT coefficient by a third, consistent with a substantial IT risk premium.

The present paper is also motivated by an IT risk explanation for high IT returns, but based on a unique event study approach.

2.2. IT-Related Event Studies

One of the first IT event studies is Dos Santos et al. (1993), who examine the impact of IT investment announcements on the market value of the firm, finding that "innovative" IT investments increase firm value, while "noninnovative" investments do not. Im et al. (2001) further explore how abnormal returns vary with key firm characteristics. Their results suggest that the reactions of price and volume are negatively related to firm size, but become more positive over time. Chatterjee et al. (2002) examine IT infrastructure investments, classifying IT investments as infrastructure or applications. They find that IT infrastructure announcements have a significantly larger price and trading volume reaction as compared to IT application announcements. Dehning et al. (2003) build on the studies described above to study the impact of the strategic role of IT, finding that abnormal returns are positive and significant only in firms where IT plays a "transformative" role.

Subramani and Walden (2001) were the first to examine the impact of electronic commerce initiatives on market value. Using a novel research design, they document evidence of significant positive cumulative abnormal returns associated with electronic commerce announcements in the fourth quarter of 1998. Dehning et al. (2004) look at the same phenomenon using market-adjusted returns,[2] and find positive abnormal returns in the fourth quarter of 1998, but insignificant (negative) abnormal returns in the fourth quarter of 2000. These results are indicative of shifting investor perceptions of returns from electronic commerce initiatives during this period, something which we also address in our empirical analysis.

Taking a different perspective on the business impact of electronic commerce, there is some research that examined the stock market reaction to ".com" name changes (Lee 2001 and Cooper et al. 2001). For example, Cooper et al. (2001) examine the impact of a ".com" name change, using an event study methodology, for data over the 1998 to 1999 period. They report significant positive abnormal returns associated with the name changes, with the largest long-horizon returns enjoyed by firms with little or no Internet sales. They interpret their findings as evidence of an "Internet mania," wherein investors wanted to be associated with the Internet at all costs.

These studies have provided useful insights into the wealth effects of technology initiatives, but they do not consider potential risk effects associated with the events, and their impact on the estimation of wealth effects, as do the studies described next.

[1] Tanriverdi and Ruefli (2004) conceptually examine the link between IT and the risk-return profile of firms, drawing on the theory of complementarities, but they do not focus on the impact of IT risk on the empirical estimation of IT returns.

[2] Market-adjusted abnormal return is defined simply as the difference between the stock return and the return on the market index.

2.3. Risk Effects in Event Studies

Significant economic events can be associated with both wealth and risk effects, and ignoring the latter can result in misestimates of the former. Studies incorporating both effects could provide a more complete understanding of the underlying phenomenon. One stream of research has examined the impact of events on the variance or volatility of stock returns. Kane and Unal (1988) investigate the variability in the risk components of banks and savings and loan companies. Ohlson and Penman (1985) study the volatility increase subsequent to stock splits. Healy and Palepu (1990) examine risk changes surrounding stock repurchase tender offers. Clayton et al. (2005) study the impact of CEO turnover on equity volatility. Hunter (2003) studies the impact of IT investments on the mean and variance of abnormal returns for a cross section of events from the retail industry, but he does not investigate the interaction between risk and return per se. Most relevant to our research is the contemporaneous working paper of Agarwal et al. (2004), which measures the impact of electronic commerce adoption on stock return volatility; however, their focus is on volatility (i.e., risk effects) alone, and not on the interaction between wealth and risk effects, which is what we study.

The joint estimation of risk and return has been conducted in a variety of contexts in the finance literature. Aharony et al. (1980) analyze the risk and return characteristics of corporate bankruptcy. Aharony and Swary (1981) measure the effects of the 1970 banking deregulation on the profitability and risk of bank holding companies. Mandelker (1974) examines the impact of mergers on the risk and return to the stockholders. Other studies use more flexible market model specifications, including the multivariate regression model, to explicitly allow for changes in the market model parameters. Applications include Allen and Wilhelm's (1988) examination of the impact of 1980 banking deregulation on market value and risk, and the investigation of the wealth and risk effects of the Glass-Steagall Act, by Bhargava and Fraser (1998) and Yu (2002).

We build on and extend the risk-return methods used in the above event studies in our analysis of the wealth and risk effects of electronic commerce announcements, using the methods described in the next section.

3. Methodologies and Hypotheses

In this section, we describe event study methodologies without and with risk effects, and provide a basis for choosing between the two types of models. Prior analyses of wealth effects of electronic commerce announcements use market model (MM) adjusted returns or the standard event study methodology. We develop our *risk-adjusted market model* (RMM), which generalizes the usual market model to allow for both event-induced variance change and changes in the market model parameters. We will show that MM is a special case of RMM, and describe the conditions under which the latter approach is preferred.

3.1. Event Study Without Risk Effects

The standard event study methodology, as described by MacKinlay (1997) and others, was previously used by Subramani and Walden (2001) in the analysis of electronic commerce announcements. In this method, the abnormal return is taken to be the difference between actual return of the stock and the expected "normal" return based on the so-called market model, which relates stock returns R_{it} to the returns on the market portfolio R_{mt} as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}, \tag{1}$$

where i indexes the firm and t indexes the date of the returns relative to the event date. In our analysis, we use the Standard and Poor's 500 as the market index. The market model is estimated over an estimation window, which is typically taken to be an interval of several months prior to the event. We take the 120 trading days prior to the event as the estimation window. Then, for each day τ within the event window, denoted by, say, $[t_1, t_2]$, the abnormal return of stock i is taken to be the difference between the actual ex post return and the predicted return from the market model,

$$\text{Model MM:} \quad AR_{i\tau} = R_{i\tau} - (\hat{\alpha}_i + \hat{\beta}_i R_{m\tau}), \quad \text{for } \tau \in [t_1, t_2], \tag{2}$$

where $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the parameter estimates from the market model (1), which we call the market model (MM) adjusted return. We omit further details of the standard event study method, referring readers to the numerous references in the literature, such as MacKinlay (1997) and Binder (1998).

3.2. Types of Risk Effects

Going back to Brown and Warner (1980), it is well known that common event study methods fail under conditions of event-induced changes in the variance of stock returns. A variety of solutions have been proposed for handling such event-induced heteroskedasticity. A common approach is to use the cross-sectional variance of the abnormal return in the event window itself instead of the usual approach of using the variance of returns in the estimation window (e.g., Charest 1978, Boehmer et al. 1991). This approach adjusts for changes in total variance, but it does not allow for changes in the market model parameters α and β themselves, as might occur in periods of market instability. As pointed out by Henderson (1990, p. 292) "if the event is important enough to change alpha and beta, then values from before the event are not appropriate," and that "the problem of alpha and beta shifts can be handled by using an estimation period around the window and testing for parameter shifts."

Note that the variance of stock returns is a measure of the total risk of the firm, while the parameter β characterizes the systematic risk component of total risk. Taking the variance of both sides of the market model (Equation (1)):

$$\mathrm{Var}(R_i) = \beta_i^2 \,\mathrm{Var}(R_m) + \mathrm{Var}(\varepsilon_i), \tag{3}$$

where $\mathrm{Var}(R_i)$ is total firm risk, β_i is the systematic risk, and $\mathrm{Var}(\varepsilon_i)$ is the unsystematic or idiosyncratic risk (see Aharony et al. 1980 for a variance decomposition analysis in the context of corporate bankruptcy). Event study designs that focus on wealth effects alone, such as MM, assume that neither total variance nor its components change as a result of the event. When such risk effects are significant, however, ignoring them can result in biased estimates of abnormal returns, as discussed in §2. In the next section we describe a risk-adjusted market model that allows for both event-induced variance change and changes in the systematic and unsystematic risk components.

We turn now to the impact of the risk effects on the estimation of wealth effects. Consider the market model (Equation (1)) and the separation of the total risk into the systematic and unsystematic risk components (Equation (3)). Suppose the event results in an increase in systematic risk β_i. Then, this will tend to raise the expected normal return, and lower the expected abnormal return. In this sense, an increase in the systematic risk should lower the magnitude of the expected abnormal return. Now suppose that the event results in an increase in the unsystematic risk, as characterized by the variance of the error term in (1). Because the variance of abnormal return is proportional to the variance of the error term (see MacKinlay 1997), an increase in unsystematic risk would reduce the significance of the abnormal return. The options pricing paradigm provides another perspective on the interaction of risk and return. It is well known that the market value of levered firms (i.e., firms with some debt in their capital structure) is increasing in both the mean and variance of earnings, based on the options nature of equity (Merton 1974, Galai and Masulis 1976). Therefore, wealth and risk effects affect market value in the same direction, and cannot be separated in event studies that lack explicit controls for risk effects—a limitation overcome by the explicit control for risk effects, as described next.

3.3. Event Study with Risk Effects

Our empirical model builds on the multivariate regression model (e.g., Binder 1985a), which allows for the simultaneous consideration of both risk and return. A key feature of this model is that it extends the estimation window to include both preevent and postevent data and allows for the market model parameters α and β to change following the event, as in Binder (1985a) and Bhargava and Fraser (1998), among others. The extended market model, which we term RMM (for risk-adjusted market model), is as follows:

$$\text{Model RMM:}\quad R_{it} = \alpha_i + \alpha_i' D_t + \beta_i R_{mt} + \beta_i' D_t R_{mt} + \gamma_i D_0 + \varepsilon_{it}. \tag{4}$$

The dummy variable D_t is set to zero before the start of the event window, and one after that. Thus, the parameters α_i' and β_i' measure the changes in the value of the parameters α_i and β_i, respectively. The dummy variable D_0 is one inside the event window and zero outside it, and it allows for the estimation of

the average *daily* abnormal return,[3] measured by the coefficient γ_i—in the market model itself.

Note that the standard event study (model MM) is a special case of RMM. Comparing Equations (1) and (4), MM can be derived from RMM by setting $\alpha' = \beta' = 0$ and estimating the resulting equation by ordinary least squares (OLS). The coefficients γ_i are then equivalent to the average of the daily abnormal returns in the standard event study method (Equation (2)). RMM will be preferred to MM whenever the joint null hypothesis $\{\alpha' = 0, \beta' = 0\}$ is rejected. In §5 we present the results of this model comparison test to show that RMM model is statistically preferred to MM for our data set.

The use of both preevent and postevent data in RMM allows for the unbundling of wealth and risk effects. To see this, consider the case where $\beta' > 0$, so that the event increases systematic risk. This would raise the expected return (Equation (4)), and correspondingly lower the estimated abnormal return, perhaps even making it insignificant. By contrast, the standard market model, estimated on preevent data alone, would result in an exaggerated abnormal return that combines both the wealth and risk effects associated with the event, masking the fact that part of the abnormal return is due to the increase in risk. In general, any model designed to detect risk changes would need to include both pre- and postevent data (see also Binder 1985a, Peterson 1989, and Henderson 1990 on this point). Finally, note that a stationary returns generation process would result in estimates of $\alpha' = \beta' = 0$, so that the inclusion of postevent data should not adversely affect the estimation of abnormal return.

The above discussion illustrates how the extended market model RMM allows for change in systematic risk β. We now discuss how we incorporate event-induced unsystematic risk changes. In the standard event study, the market model is estimated using OLS, under the assumption that the residuals of the model, ε_{it}, are i.i.d. Note that the unsystematic risk is measured by $\mathrm{Var}(\varepsilon_{it})$. When there is event-induced unsystematic risk change, the homoskedasticity assumption of OLS is violated, and GLS needs to be used to get the best linear unbiased estimator (BLUE). Specifically, we use groupwise heteroskedasticity (see, e.g., Greene 2000) to adjust for the possibility that unsystematic risk after the event is different from that in the preevent period.

We started our analysis by estimating Equation (4) firm by firm. However, when there is an event-clustering problem (MacKinlay 1997, Binder 1998), which causes the market model residuals to be correlated across firms, our estimation needs to adjust for contemporaneous correlation. To deal with the event-clustering problem, the extended market model (4) is estimated using Zellner's (1962) seemingly unrelated regression (SUR). For each data set, we use a common (across events in each data set) calendar-date estimation window instead of relative date estimation windows as in MM.[4] Specifically, for all of the events in a given year's data set, the calendar-date estimation window runs from six months before the starting date of the data set to six months after the last event date in the data set. In addition, we incorporate the heteroskedasticity adjustment described above. A detailed specification of the resulting model is provided in Appendix A. It is worth pointing out that this specific implementation of the multivariate regression model is unique (to the best of our knowledge) in its ability to simultaneously handle event clustering, event-induced variance change, and any market model instability.

To enhance the confidence in our results, we estimate RMM not just on the test sample of events, but on a control sample as well, constructed using the guidelines provided by Barber and Lyon (1996). For each event in the test sample, we added a matching firm into the control sample, based on the following search criteria: (i) the control firm is from the same two-digit SIC as the firm in the test sample; (ii) the firm did not make an electronic commerce announcement around the same time as the original firm in the test sample; (iii) the preevent beta (i.e., systematic risk parameter) of the firm is within plus or minus 25% of the preevent beta of the test firm (the betas

[3] This is in contrast to the average cumulative abnormal returns (CAR) reported in Subramani and Walden (2001) and other studies—a distinction to be kept in mind when comparing our results to corresponding ones in the literature.

[4] We thank an anonymous reviewer for providing useful guidance on the choice of appropriate estimation windows.

are computed from two years of daily stock market data preceding the event window); and (iv) if there are multiple firms satisfying the previous criteria, pick the one with the closest average daily return over the two years prior to the event.[5] The RMM method is applied to the firms in the control sample in exactly the same way that it is applied to the test sample.

3.4. Development of Hypotheses

We start with the nature of risk effects associated with electronic commerce initiatives, drawing on Swanson's (1994) theory of IS innovations, broadly defined as "the organizational application of digital computer and communication technologies." The theory is built around a carefully developed taxonomy of IS innovations, which posits three types of innovations (Types I, II, and III) that are increasingly stronger in terms of their business impact. Specifically, Type I innovations are restricted in their impact to the IS task alone, while Type II innovations additionally affect business processes. Type III innovations are more comprehensive in their scope, impacting not only information systems and business processes, but also core work processes, business administration, and coordination with business partners and customers. As examples, Swanson (1994) notes that investments in data administration technologies and end user computing technologies (such as PCs) tend to be Type I and Type II innovations, respectively, whereas the adoption of electronic data interchange (EDI) or materials resource planning (MRP) are Type III innovations.

One would expect these different types of innovations to have different effects on the risk-return profile of firms. Specifically, Type III innovations are likely to be riskier due to their comprehensive scope and strategic nature, as compared to more narrowly focused IT initiatives corresponding to Type I or Type II innovations. We believe that electronic commerce initiatives studied here exemplify Type III innovations in Swanson's (1994) framework. As described in Porter (2001), Internet-enabled innovations can broadly affect all of the stages in a firm's value chain (such as inbound logistics, operations, outbound logistics, etc.) as well as the shared support and infrastructural processes. The resulting impact can be strategic in nature, with the potential of reshaping the five "forces of competition" (Porter 2001).[6]

Indeed, Porter's (2001) conceptual analysis of the impact of the Internet on industry structure persuasively argues that the Internet is more likely to *decrease* average industry profits than to increase them. Specific ways in which Internet adoption might depress profitability include: lowered barriers to entry because both the fixed and variable costs of doing business are reduced; shift towards price competition due to the reduction in variable costs relative to fixed costs; increased buyer bargaining power due to lower search and customer switching costs; increased threat of substitute products or services due to the increased transparency of competitive strategies and tactics in product markets; and increased bargaining power of suppliers due to downstream entry and the added threat of disintermediation. On the other hand, the Internet can also enable higher profits by reducing the bargaining power of distribution channels; increasing geographical scope of the market; and increasing the bargaining power over suppliers due to Internet sourcing and procurement. Thus, the impacts of the Internet can be both positive and negative, so that electronic commerce announcements will tend to create uncertainty in the minds of investors regarding the impact on future cash flows and profits. Based on this discussion, we hypothesize that:

Hypothesis 1. *Electronic commerce announcements are associated with significant risk effects.*

We turn now to a discussion of the impact of electronic commerce on systematic and unsystematic components of total firm risk. With respect to the latter, note that much of the strategic uncertainty associated with the adoption of the Internet, as described above, is specific to individual firms or industries. Accordingly, the corresponding risk effects are likely to be idiosyncratic in nature, potentially diversifiable by investors. Therefore, we would expect increased

[5] For firms that do not have two years of daily stock market data, we use all available data to compute preevent betas and average daily returns.

[6] The five forces are intensity of competitive rivalry, barriers to entry, the threat of substitute products, bargaining power of suppliers, and the bargaining power of buyers.

levels of unsystematic risk to go hand in hand with increased overall risk effects. But to what extent are the risk effects of electronic commerce initiatives systematic or nondiversifiable?

Prior research has highlighted three drivers of nondiversifiable or systematic risk: intrinsic business risk, the degree of operating leverage, and the degree of financial leverage (see, e.g., Lev 1974, Mandelker and Rhee 1984, and Ho et al. 2004). Intrinsic business risk is primarily related to the cyclicality of sales revenues, or the extent to which sales revenues are correlated to marketwide returns. The degree of operating leverage measures the ratio of fixed to variable costs, as also reflected in the capital to labor intensity of the firm's production system. Finally, the degree of financial leverage refers to the ratio of debt to equity in the firm's capital structure. The systematic risk of a firm's equity is increasing in each of these factors (see, e.g., Brealey and Myers 2002).

In terms of the impact of electronic commerce on systematic risk, the clearest effect is via its effect on the degree of operating leverage—systems for electronic commerce add to the fixed costs of a firm while driving down variable costs (and profit margins, under competition). The digitization of business processes underlying electronic commerce tends to substitute IT capital for labor, further increasing the degree of operating leverage. With respect to inherent business risk, one could argue that electronic commerce would result in a reduced cyclicality of sales revenues, due to an increased diversity of (online and offline) sales channels and a broadening of customer base and revenue sources. We do not think there is any systematic relationship between electronic commerce initiatives and the degree of financial leverage of the firm. Overall, the impact of electronic commerce would be to increase (decrease, respectively) systematic risk through its impact on the degree of operating leverage (inherent business risk, respectively). The net effect on systematic risk is therefore ambiguous. Still, for the sake of empirical testing we take the position that electronic commerce increases systematic risk, leading to the following hypothesis:

Hypothesis 2. *Electronic commerce announcements are associated with an increase in both the unsystematic and systematic risk components of total firm risk.*

The last part of our analysis deals with how the nature of risk effects varies with the type of electronic commerce initiative. We explore risk differences along the following dimensions: *new* electronic commerce initiative versus *expansion* of an existing application; *digital* goods or services versus *tangible* goods; and *B2C* versus *B2B* electronic commerce application. In analyzing differences in risk effects, we draw from theories of organizational learning (Winter 1971, Levinthal and March 1981, and March 1991) that distinguish between "exploration" and "exploitation" activities in firms, as also invoked by Hunter (2003) in his analysis of the mean and variance of the abnormal return of IT announcements (but not the interaction between risk and return) in the retail industry. In the words of March (1991, p. 73), "compared to returns from exploitation, returns from exploration are systematically less certain, more remote in time, and organizationally more distant from the locus of action and adaptation." The relevant take-away from this theory from our point of view is that activities that incorporate more exploration relative to exploitation are generally associated with higher levels of vulnerability and risk.

Because new initiatives involve significant exploration, whereas an expansion of an existing application involves more exploitation by comparison, we expect that new initiatives would be riskier than expansions. A similar argument applies to the case of digital versus tangible goods electronic commerce initiatives. A larger portion of the value chain for digital goods and services is likely to be online, whereas for tangible goods only distribution is conducted online, with production largely in traditional offline environments. To the extent that online processes are relatively new, with most firms still at an exploration stage, we would expect the commerce of digital goods to involve a higher proportion of exploration versus exploitation, as compared to the case of tangible goods—and therefore exposure to correspondingly higher risk.

Finally, consider the distinction between B2C and B2B types of electronic commerce, in which the former involves sales of products and services to individual consumers, whereas the latter primarily involves supply chain coordination and trade between business partners. To the extent that the

online channel is new for both firms and consumers, B2C applications involve exploration on the part of both firms and consumers. On the other hand, a common application of B2B initiatives, especially private trading exchanges, is to exploit existing relationships between business partners (see, e.g., Stevens 2002). Therefore, we expect a higher proportion of exploration versus exploitation in B2C, as compared to B2B applications, and correspondingly higher risk. These arguments lead us to the following hypothesis:

Hypothesis 3. *The risk perceived by investors would be relatively higher for*: (a) *new electronic commerce initiatives as compared to expansions of existing applications*; (b) *digital goods and services as compared to tangible goods*; *and* (c) *B2C as compared to B2B initiatives*.

These hypotheses will guide our empirical analysis, based on the data set described next.

4. Data and Descriptive Statistics

Our data collection procedure tracked electronic commerce announcements in PR Newswire and Business Wire in Lexis-Nexis by using the search terms *launch* or *announce* within the same sentence as the words *online* or *commerce*, and *.com* and *AMEX* or *NASDAQ* or *NYSE*—along the lines of Subramani and Walden (2001). For a comprehensive analysis of the shifting risk-return perceptions in the initial years of electronic commerce announcements, we collected data from four distinct time periods, two years apart: 1996, 1998, 2000, and 2002. To be able to compare our results to prior research, we collected data for the fourth quarter of 1998 (as in Subramani and Walden 2001) and fourth quarter of 2000 (as in Dehning et al. 2004). Because of relatively sparse electronic commerce announcements in 1996 and 2002, we expanded our data collection in these two time periods to the second half of 1996 and the whole year of 2002. We picked our data samples two years apart to achieve a clear separation between different periods of electronic commerce adoption, and to account for any transient periods of market instability in our data set.

Table 1 documents the steps in our data-filtering process along with the number of observations left after each step. The criteria we used to identify an announcement as an electronic commerce event is the same as Subramani and Walden (2001). Our initial search using the search terms described above generated 376 announcements in 1996, 680 in 1998, 1,543 in 2000, and 1,983 in 2002. Following standard practice, we first dropped irrelevant announcements and firms that were not publicly traded. We also dropped firms with less than 120 days' trading history prior to the events, or whose stocks average price in the estimation period was less than \$1, or whose average daily trading volume was less than 50,000 shares. Further, we dropped firms with multiple electronic commerce announcements or confounding announcements within a three-day window around the event date, which is the length of event window in our main model. Consistent with prior research, we considered the following types of news as confounding announcements: earnings announcements, significant personnel changes, mergers and acquisitions, stock upgrades or degrades, lawsuits, and site traffic volumes. Finally, we eliminated events for firms that happened to be delisted soon after the events. After these steps, we were left with 67 events in 1996, 152 in 1998, 215 in 2000, and 206 in 2002. A detailed listing of events in our data set is provided in Appendix B. Corresponding to these events, we obtained matching stock market data from the Center for Research in Security Prices (CRSP) daily return tape.

Table 1 Data Screening Process

	Number of events			
Filter	1996	1998	2000	2002
Initial search	376	680	1,543	1,983
Drop irrelevant announcements and private firms	120	233	397	307
Drop firms with less than 120 days trading history; or less than \$1 average price; or less than 50 K average daily trading volume	97	165	323	269
Drop firms with multiple electronic commerce events and/or confounding events	67	156	227†	212
Drop firms delisted soon after the events	67	152	215	206

Notes. The table shows the number of observations remaining after each stage of the data screening process.

†This number reflects the dropping of 30 events for which RMM estimation models were not of full rank.

Table 2 Summary Statistics by Industry Classification

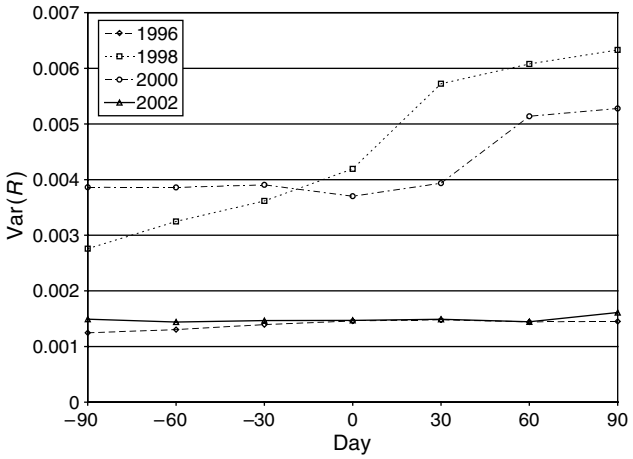
	Manufacturing	Transportation and utilities	Trade	Finance, insurance and real estate	Other services	Overall sample
1996						
N	18	9	3	6	31	67
Market value	14.43	25.90	2.06	14.32	14.47	15.43
Trading volume	1.30	1.13	0.42	0.64	1.83	1.42
1998						
N	19	13	33	20	67	152
Market value	9.26	46.92	2.09	17.29	30.04	21.14
Trading volume	4.00	2.05	1.43	1.21	5.64	3.63
2000						
N	31	20	20	31	113	215
Market value	27.51	46.43	2.33	38.91	20.42	24.85
Trading volume	2.88	4.61	0.61	2.96	5.03	3.97
2002						
N	32	26	30	37	81	206
Market value	15.60	36.73	16.91	32.16	41.20	31.50
Trading volume	2.08	4.63	3.10	2.61	11.13	6.20

Notes. Market values are for the event day averaged across the cross section of firms, and reported in billions of dollars. Trading volumes are also for the event day averaged across the cross section of firms, and reported in millions of shares.

Descriptive statistics are presented in Table 2, which shows the average market value and average trading volume on the event day, broken down by year and industry type, in which the categories are: Manufacturing; Transport and Utilities; Trade; Finance, Insurance and Real Estate; and Other Services. We find that the firms in our sample are somewhat larger (in terms of market value) than the average firm in their respective industry segments, but comparable in terms of profits, stock market returns, and beta. The average market value (on the event day) is \$15.43 billion for the 1996 sample, \$21.14 billion in 1998, \$24.85 billion in 2000, and \$31.50 billion in 2002, with the average trading volume figures also displaying a similar growth across the time periods. These trends reflect the fact that smaller firms were the first to launch electronic commerce initiatives, with increasingly larger companies following over time.

Figure 1 depicts the evolution in the variance of stock market returns from 90 days before the event dates through 90 days past the event dates—one line each for the four annual data periods. The points on each line show the moving average (over 120 days) of the average variance of stock returns, depicted over time relative to the event day 0. It is clear from the graph that stock return volatility is substantially elevated in 1998 and 2000, as compared to the years 1996 and 2002. Further, there appears to be a postevent increase in variance during 1998 and 2000. A similar bounce in variance does not occur in 1996 and 2002, with the lines corresponding to these years remaining flat. We also performed the variance partition analysis

Figure 1 Variance of Returns in Event Time



Note. Each data point represents the average variance of returns over the previous 120 days.

Table 3 Average Total Risk and Unsystematic Risk

		Total risk			Unsystematic risk		
Year	*N*	Preevent	Postevent	Difference *t* stat	Preevent	Postevent	Difference *t* stat
1996	67	0.0014 (0.0013)	0.0015 (0.0017)	0.60	0.0013 (0.0013)	0.0014 (0.0017)	0.66
1998	152	0.0043 (0.0047)	0.0073 (0.0176)	2.02**	0.0038 (0.0046)	0.0069 (0.0176)	2.15**
2000	215	0.0037 (0.0063)	0.0059 (0.0075)	3.31***	0.0034 (0.0063)	0.0051 (0.0072)	2.67***
2002	206	0.0015 (0.0018)	0.0017 (0.0020)	1.25	0.0012 (0.0017)	0.0013 (0.0019)	0.98

Notes. Standard deviations are in parentheses. *** and ** denote significance at 1% and 5%, respectively, for a two-tailed test. The preevent and postevent estimation windows include 120 days before and after the event date, respectively.

of Equation (3) for the preevent period and postevent period (here, the preevent period covers 120 trading days prior to the events, while the postevent period includes the 120 trading days immediately following the events), and tested the significance of change in total risk and unsystematic risk.[7] The results, presented in Table 3, indicate that the subsamples for the years of 1998 and 2000 demonstrate significant increases in both total risk and unsystematic risk. On the other hand, there is no significant change in the average total risk and unsystematic risk for 1996 and 2002.

For the sake of conducting a cross-sectional analysis of the drivers of risk change, we coded our data sets to distinguish between events along three dimensions: *new* electronic commerce initiatives versus *expansion* of existing electronic commerce initiatives; *digital* goods or services versus *tangible* goods (i.e., does the electronic commerce initiative deal with a physical product or a digital product or service); *B2C* versus *B2B* electronic commerce initiatives. The coding of events was based on the analysis of the full text of the announcements, and we used a single rater to code the entire data set. An event was coded as *new* if the announcement describes a new electronic commerce initiative for the firm or if it is a new joint project by multiple firms. An initiative was coded as *expansion* if its purpose is to expand existing electronic commerce capabilities of the firm. The other two dimensions of coding were similar to Subramani and Walden (2001): An initiative was coded as *B2C* if it involves transactions between a firm and end customers (and *B2B*, respectively, if the transactions are between business partners); and a *digital* goods coding was recorded if the initiative results in digital goods or services becoming available online (*tangible* goods coding, respectively, if online transactions of tangible goods). Of the total 640 events in our data set, 417 were coded as new initiatives and 211 as expansions (12 events were unclassified because of insufficient information in the announcements); 426 were coded as B2C and 210 as B2B (4 were unclassified); 506 were coded as digital goods initiatives, 126 were coded as tangible goods (8 were unclassified). We provide illustrative samples of each classification in Appendix C.

5. Empirical Results

At the outset, it is useful to point out a few salient aspects of our analysis. First, we present results by year separately for 1996, 1998, 2000, and 2002—as we explained, our objective is in part to understand the shifting perceptions regarding risk and return. Second, we conduct all of our analysis for two distinct event windows $[-1, +1]$ and $[-10, +10]$; that is, one relatively long and another comparatively short event window.[8] The longer window is chosen because

[7] The changes in systematic risk will be shown in the analysis of the RMM model.

[8] Based on the suggestion of an anonymous reviewer, we also replicated our results for the $[-10, +1]$ event window and found that the qualitative nature of our results was unchanged.

Table 4 MM and RMM Abnormal Return Estimates

		Event window [−1, +1]				Event window [−10, +10]			
Year	*N*	MM $\overline{CAR}$ (*t* stat)	MM $\overline{AR}$ (*t* stat)	RMM $\overline{AR}$ (*t* stat)	RMM vs. MM Joint test of $\{\alpha' = 0, \beta' = 0\}$	MM $\overline{CAR}$ (*t* stat)	MM $\overline{AR}$ (*t* stat)	RMM $\overline{AR}$ (*t* stat)	RMM vs. MM Joint test of $\{\alpha' = 0, \beta' = 0\}$
1996	67	0.15% (0.20)	0.05% (0.20)	−0.02% (−0.08)	$F = 7.23^{***}$	1.18% (0.59)	0.06% (0.59)	−0.05% (−0.45)	$F = 6.22^{***}$
1998	152	2.94%*** (3.43)	0.98%*** (3.43)	0.65% (1.63)	$F = 5.35^{***}$	10.89%*** (4.78)	0.52%*** (4.78)	0.24% (1.46)	$F = 7.20^{***}$
2000	215	−1.29%* (−1.87)	−0.43%* (−1.87)	−0.65%** (−2.27)	$F = 20.04^{***}$	−4.49%** (−2.47)	−0.21%** (−2.47)	−0.45%*** (−3.93)	$F = 25.70^{***}$
2002	206	0.17% (0.41)	0.06% (0.41)	0.05% (0.31)	$F = 5.31^{***}$	−0.85% (−0.78)	−0.04% (−0.78)	−0.07% (−1.16)	$F = 4.91^{***}$

Notes. ***, **, and * denote significance at 1%, 5%, and 10%, respectively, for two-tailed tests. To facilitate the comparison between MM and RMM, both models are estimated here using relative date event windows and no correction for event clustering; MM uses an estimation window of 120 trading days prior to the event, while the RMM estimation window runs from 120 days prior to 120 days after the event. The average daily abnormal return MM $\overline{AR}$ is dividing MM $\overline{CAR}$ by the number of days in the event window, and is comparable to RMM $\overline{AR}$. RMM $\overline{AR}$ is the average daily abnormal return γ in RMM model.

information regarding electronic commerce initiatives might be leaked in advance of the actual event; another reason is for the sake of comparing our results with those from prior research by Subramani and Walden (2001) and Dehning et al. (2004). The shorter window is likely to more accurately reflect the information content of the electronic commerce announcement itself. Considering both event windows also provides a measure of robustness to the analysis.

5.1. Event Study Without Risk Effects

We start with the standard event study without risk effects (MM model), for which the results, shown in Table 4, are broadly consistent with the results of prior research (Subramani and Walden 2001). Average abnormal returns are positive and significant in 1998 for both event windows. The cumulative abnormal returns (i.e., MM $\overline{CAR}$) are estimated to average 2.94% for the $[-1, +1]$ event window and 10.89% for the $[-10, +10]$ event window, and both are significant at the 1% level. Abnormal returns in 2000 are negative and significant for both the short and long event windows. The abnormal returns in 1996 and 2002 are not significant. Put together, our results from the standard event study model indicate shifting perceptions of returns associated with electronic commerce announcements during the time frame of our study. The key question then is the extent to which the shifts in perceptions of returns are related to contemporaneous shifts in risk perceptions, which we address in the following subsection.

Table 4 also presents the average daily abnormal returns from RMM, followed by results for a model comparison test of RMM versus MM. As discussed in §3.3, the estimation of the RMM model yields average *daily* abnormal return instead of *cumulative* abnormal return as in the standard event study (MM model). So we compare the MM and RMM models on the basis of daily average abnormal returns. The daily average abnormal return of MM model (i.e., MM $\overline{AR}$) is MM $\overline{CAR}$ divided by the number of days in the event window. As can be seen from the table, RMM $\overline{AR}$ is lower than MM $\overline{AR}$, which indicates that the wealth effects are reduced once the contemporaneous risk effects are taken into account (more on this below). Recall from §3.3 that the model comparison test of RMM versus MM amounts to a test of the joint null hypothesis $\{\alpha' = 0, \beta' = 0\}$. This test yields the uniformly significant *F*-values reported in Table 4, indicating that RMM is statistically preferred to MM for all four data sets.

5.2. Event Study with Risk Effects

The results for wealth and risk effects obtained from the RMM model is presented in Table 5. The top panel in the table contains the results for the test sample, whereas the bottom panel corresponds to the control sample (described in §3.3)—for both samples we present results separately for each of the four years

Table 5 RMM Results for the Test and Control Samples

		Event window $[-1,+1]$					Event window $[-10,+10]$				
Year	N	α	α' (F stat)	β	β' (F stat)	γ (F stat)	α	α' (F stat)	β	β' (F stat)	γ (F stat)
Test sample											
1996	67	−0.0003	0.0003 (0.54)	1.24	−0.17*** (8.67)	−0.04% (0.04)	−0.0002	0.0001 (0.02)	1.25	−0.17*** (9.14)	0.02% (0.09)
1998	152	0.0023	0.0016** (6.51)	1.40	−0.03 (0.43)	0.26% (1.82)	0.0021	0.0017** (5.55)	1.37	0.04 (0.64)	0.06% (0.50)
2000	215	−0.0021	0.0021*** (19.83)	1.51	0.15*** (22.66)	−0.39%*** (15.82)	−0.0020	0.0024*** (18.19)	1.49	0.20*** (43.16)	−0.31%*** (29.37)
2002	206	0.0007	−0.0001 (0.31)	1.17	−0.10*** (53.29)	0.11% (2.50)	0.0006	0.0001 (0.27)	1.18	−0.09*** (51.68)	−0.04% (1.40)
Control sample											
1996	67	−0.0001	0.0003 (0.68)	0.96	−0.07 (2.35)	0.21% (1.50)	0.0001	0.0003 (0.51)	0.96	−0.07 (2.22)	−0.08% (1.16)
1998	152	−0.0009	0.0029*** (48.38)	1.05	−0.21*** (39.84)	−0.07% (0.30)	−0.0008	0.0025*** (29.56)	1.05	−0.23*** (54.04)	−0.003% (0.00)
2000	215	−0.0010	0.0026*** (28.32)	1.42	0.07** (4.12)	−0.47%*** (21.36)	−0.0011	0.0032*** (32.25)	1.41	0.09*** (7.59)	−0.38%*** (42.99)
2002	206	0.00001	−0.0001 (0.26)	1.06	−0.01 (0.77)	−0.06% (0.76)	−0.0002	0.0002 (0.70)	1.06	−0.01 (1.11)	−0.05% (2.14)

Notes. *** and ** denote significance at 1% and 5%, respectively. RMM results are based on SUR estimation using a calendar-date estimation window running from six months prior to the starting date of the data set to six months after the ending date of the data set. γ is the average daily abnormal return. One significant outlier (observation 96 in Appendix B) was dropped from the analysis.

represented in our data set, and for the two event windows $[-1,+1]$ and $[-10,+10]$. In each case, we first present the average of the estimated values of the RMM model parameters, followed by the average daily abnormal return γ. Overall, the results for the two event windows are consistent with one another. The significant changes in the market model parameters α and β suggest that the stationarity assumption implicit in the MM model does not hold, justifying the use of the extended market model (Equation (4)) for our data set.

Looking at the results for the test sample over the $[-1,+1]$ event window, note first that in most cases the market model parameters change significantly from the preevent to the postevent period (i.e., α' and β' are generally nonzero and statistically significant). Specifically, β' is negative and significant in 1996 and 2002, not significant in 1998 and positive and significant in 2000. Turning to the average daily abnormal returns, note that the estimates of γ are not significant, except for 2000, where it is negative and significant (more on this below). Comparing the abnormal returns from RMM to those from the MM model (Table 4), note that in 1998 the abnormal return is positive and significant in MM, but not significant in RMM, whereas in 2000, the abnormal return in MM is negative and significant at the 10% level, and it is even more negative and significant (at the 5% level) under RMM. Results for event window $[-10,+10]$ are similar to those for $[-1,+1]$. Generally, as a consequence of allowing for risk changes, the abnormal returns are lower in RMM as compared to MM. Turning to the control sample results in the lower panel, note that the results are different from those for the test sample and generally none of the parameters are significant, as one might expect.[9] The exception is the year 2000, where the results for the test sample are virtually identical to those for the control sample (more on this below).

For the sake of a robustness check, we conduct nonparametric tests of significance for the abnormal returns from the RMM model. The results are

[9] The significant change in market model parameters in the 1998 control sample are most likely a reflection of the market instabilities during this period.

Table 6 Nonparametric Test Results

		Event window [−1, +1]			Event window [−10, +10]		
Year	*N*	Mean (%)	Sign test (M)	Rank test (S)	Mean (%)	Sign test (M)	Rank test (S)
Test sample							
1996	67	−0.04	−1.5	18	0.02	2.5	46
1998	152	0.26	0	520.5	0.06	7	662
2000	215	−0.39	−13*	−1,890**	−0.31	−27.5***	−3,740***
2002	206	0.11	4	719.5	−0.04	−6	−891
Control sample							
1996	67	0.21	5.5	153.5	−0.08	3.5	−29.5
1998	152	−0.07	−5	−314.5	−0.003	0	109
2000	215	−0.47	−13.5*	−2,170.5**	−0.38	−15**	−3,160.5***
2002	206	−0.06	−8	−1,100.5	−0.05	−9	−1,296

Notes. These results are from the RMM model. ***, **, and * denote significance at 1%, 5%, and 10%, respectively, for two-tailed tests.

reported in Table 6, based on two different nonparametric tests: the sign test and the rank test. The results are largely consistent with the parametric test results of Table 5; that is, the abnormal returns are not significant for either the test sample or the control sample, except for the year 2000, where the abnormal returns are negative and significant—for *both* the test and control samples.

This brings us to the question of how to explain the puzzling outcome for the year 2000, where the outputs from the test and control samples are similar to each other, despite the fact that the control sample had no electronic commerce announcement on the dates under consideration. Given that the results are similar with or without electronic commerce announcements suggests that the abnormal returns are not a reflection of the specific events under consideration, but rather that they are an artifact of sharply deflating stock prices in the fourth quarter of 2000. Indeed, the decline is so sharp that it drowns out any event-specific effects, so that the test and control samples behave similarly to each other. Thus, despite its flexibility, the RMM model is unable to resolve differences between the test and control samples for our 2000 data set. Specifically, we are unable to reject the null hypothesis of zero (event-related) abnormal returns in 2000.

Our key qualitative findings with respect to wealth and risk effects are summarized in Table 7. Once contemporaneous risk changes are taken into account, wealth effects are either not significant or, when they are significant, they cannot be reliably linked to electronic commerce announcements. The risk effects are generally significant and quite different during different time periods. We find significant event-induced increases in both total and idiosyncratic risks in 1998 and 2000, but not in 1996 and 2002. On the other hand, systematic risk (beta) decreases significantly in 1996 and 2002, possibly due to the fact that the reduced cyclicality of sales revenues and the corresponding reduction in intrinsic business risk outweighs the effects of increased operating leverage (recall our discussion related to Hypothesis 2 §3.4).

5.3. Cross-Sectional Analysis of Risk Effects

To further understand the drivers of the significant risk effects summarized in Table 7, we now conduct a cross-sectional analysis relating risk changes to various event and firm characteristics. Note that we restrict our cross-sectional analysis to risk effects, because we have found that wealth effects are not significant once risk effects are taken into account. Our analysis examines the determinants of both systematic and unsystematic risk, and is guided by Hypothesis 3 of §3.4. Note that while the hypothesis is stated at the level of total risk, and does not distinguish

Table 7 Summary of Wealth and Risk Effects

		Risk effects		
Year	Wealth effects	Systematic	Unsystematic	Total
1996	Not significant	**Decreasing**	Not significant	Not significant
1998	Not significant	Not significant	**Increasing**	**Increasing**
2000	Not significant	Not significant	**Increasing**	**Increasing**
2002	Not significant	**Decreasing**	Not significant	Not significant

between systematic and unsystematic risk components, we expect that both risk components tend to increase with total risk, and therefore the predictions underlying Hypothesis 3 should, on average, apply to both risk components.

In terms of the empirical specifications, we consider both event characteristics (as described in §4) and a variety of firm-level controls that might be correlated with risk changes. These controls are firm size (because one might expect higher risk change for smaller firms), preevent firm risk (to normalize the magnitude of risk change), and return (because risk and return are inherently related to each other). We also include a dummy variable for time effects, coded as one for 1998 and 2000, and zero for 1996 and 2002, to account for shifting perceptions of risk during this time period, as is clear from Figure 1. We estimate two different regression specifications, one each for the systematic and unsystematic risk components, respectively:

$$\begin{aligned}\Delta\text{SysRisk}_{it} &= \alpha_0 + \alpha_1\text{Size}_{it} + \alpha_2\text{PreSysRisk}_{it} + \alpha_3\text{Ret}_{it} \\ &\quad + \alpha_4\text{New}_{it} + \alpha_5\text{Tangible}_{it} + \alpha_6\text{B2B}_{it} \\ &\quad + \alpha_7\text{Time}_t + \varepsilon_{it}, \qquad (5)\\ \Delta\text{UnsysRisk}_{it} &= \gamma_0 + \gamma_1\text{Size}_{it} + \gamma_2\text{PreUnsysRisk}_{it} \\ &\quad + \gamma_3\text{Ret}_{it} + \gamma_4\text{New}_{it} + \gamma_5\text{Tangible}_{it} \\ &\quad + \gamma_6\text{B2B}_{it} + \gamma_7\text{Time}_t + \varepsilon_{it}. \qquad (6)\end{aligned}$$

For firm i in time period t ($t = 1996$, 1998, 2000, or 2002):

$\Delta\text{SysRisk}_{it}$ = Change in magnitude of systematic risk from the preevent period to the postevent period (i.e., the parameter β' in the RMM analysis);

$\Delta\text{UnsysRisk}_{it}$ = Change in magnitude of unsystematic risk from the preevent period to postevent period;

Size_{it} = Firm size, as proxied by the logarithm of market value on the event day;

PreSysRisk_{it} = Preevent beta (i.e., the parameter β in the RMM analysis);

PreUnsysRisk_{it} = Preevent unsystematic risk calculated from Equation (3) over the 120 days before the event;

Ret_{it} = Stock return over the two years prior to the event;[10]

$\text{New}_{it} = 1$ for new electronic commerce capability; 0 for expansion of existing electronic commerce capability;

$\text{Tangible}_{it} = 1$ for tangible goods electronic commerce initiative; 0 for digital goods or services;

$\text{B2B}_{it} = 1$ for a B2B type of electronic commerce initiative; 0 for B2C;

$\text{Time}_{it} = 1$ for events in 1998 or 2000; 0 for 1996 or 2002.

We pool our four data sets to run the OLS regressions of Equations (5) and (6), and the results are reported in Table 8,[11] with the two columns corresponding to systematic and unsystematic risk change, respectively. Starting with the former, the results suggest that electronic commerce in tangible goods is perceived to be less risky than electronic commerce for digital goods and services, consistent with Hypothesis 3(b). Further, the coefficient on the B2B dummy variable is negative and significant, indicating that B2B electronic commerce announcements are perceived to be less risky, in terms of systematic risk, relative to B2C electronic commerce initiatives, consistent with Hypothesis 3(c). However, Hypothesis 3(a) is not borne out by our results, because the coefficient on the dummy variable for New versus Expansion is not significant (although it has the predicted sign). The negative coefficient on Preevent Risk is puzzling, but it might simply be indicative of a regression to the mean. Finally, the coefficient on the time effect dummy variable is positive and significant (at the 1% level), reflecting the shift in risk perceptions of electronic commerce announcements. The last column of Table 8 reports the results from analysis of unsystematic risk changes. It shows that only firm size, preevent unsystematic risk, and time effect have significant coefficients, whereas none of the event characteristics are significant (although they have the predicted signs). The lack of sharp results for unsystematic risk change is probably due to the confounding effects of market instabilities during this period, especially in the year 2000. However, the results for

[10] For firms that do not have two years of stock market data, we use all available data to compute preevent stock returns.

[11] There is no collinearity problem with the OLS regressions, as evidenced by the fact that the VIF index is below two for all variables. We also performed the standard winsorization procedure to handle data outliers and reran the OLS regressions, getting qualitatively similar results.

Table 8 Determinants of Systematic and Unsystematic Risk Changes

	Dependent variables	
Independent variables	Systematic risk change	Unsystematic risk change
Constant	−0.0338	0.0073***
	(0.1608)	(0.0011)
Firm size (log market value)	0.0164*	−0.0005***
	(0.0093)	(0.0001)
Preevent risk	−0.2263***	−0.2174***
	(0.0328)	(0.0500)
Preevent stock return	0.0899***	0.0001
	(0.0224)	(0.0001)
New vs. expansion	0.0527	0.0001
dummy variable	(0.0466)	(0.0003)
Tangible vs. digital	−0.1170**	−0.0004
dummy variable	(0.0551)	(0.0003)
B2B vs. B2C	−0.0847*	−0.0001
dummy variable	(0.0478)	(0.0003)
Time effect dummy variable	0.2134***	0.0013***
	(0.0491)	(0.0003)
Adj. R^2	0.1213	0.1046
N	618†	618†

Notes. †The number of observations reduces from 640 to 618 because of unclassified electronic commerce announcements. Standard errors are in parentheses. ***, **, and * denote significance at 1%, 5%, and 10%, respectively, for two-tailed tests.

systematic risk change are broadly consistent with our hypotheses.

6. Conclusions

In this paper, we have jointly examined the wealth and risk effects associated with electronic commerce announcements in the 1996 to 2002 time period. The incorporation of risk effects into the event study methodology is premised on the fact that significant economic events can affect more than the mean of the returns distribution, so that both *wealth* and *risk* effects can be discerned in capital market data. These risk effects, which characterize the impact of the event on the riskiness or uncertainty of stock market returns, are not only interesting in their own right but, when significant, their omission can result in biased estimates of wealth effects.

We implement an adaptation of the multivariate regression model, which not only enables the joint estimation of wealth and risk effects, but the specification is flexible enough to accommodate event-induced variance changes as well as changes in market model parameters. A key finding is that wealth effects are not significant, once contemporaneous risk changes are controlled for. We find that increased unsystematic risk effects in the 1998 to 2000 time frame, but decreased systematic risk in 1996 and 2002. Thus, while much of the added risk due to electronic commerce activities is in fact diversifiable, we find some evidence that the use of new online channels and activities might actually reduce intrinsic business risk, perhaps due to reductions in demand uncertainty and cyclicality of sales revenues.

This event study analysis nicely complements prior work by Dewan et al. (2007), which investigates the IT risk and return relationship in secondary firm level data using production function and market value specifications. Our finding that the size and significance of wealth effects is reduced by the inclusion of risk effects in the event study is also broadly consistent with an IT risk explanation for the new productivity paradox (see Dewan et al. 2007, §2.1).

To summarize our contributions, we add to the emerging IT investments literature on IT risk and on the interaction between risk and return. Focusing on the specific context of electronic commerce announcements, we provide a theoretical basis for understanding the nature of risk effects, how these effects vary with event and firm characteristics, and how they affect the estimation of wealth effects. In terms of methodology, this is the first paper in the IS literature to use an event study methodology to examine the interaction between risk and return. While we do not claim a methodological contribution per se, we have implemented a generalized and flexible event study model, uniquely suited to the nature of early electronic commerce announcements. Our results shed light on the riskiness of technology initiatives, and demonstrate the potential importance of controlling for risk changes in the estimation of wealth effects.

At a higher level, our analysis also provides some theoretical guidance for future researchers in terms of understanding what types of events might be associated with risk changes. At the same time, we would be remiss to not point out that the vast majority of event studies that focus on wealth effects alone are not necessarily misspecified. Indeed, even the simplest event study designs are perfectly adequate in most circumstances (see, e.g., Peterson 1989, Henderson 1990). This is because risk effects are typically

not significant, so that their omission usually does not adversely affect the estimation of wealth effects. In the case of electronic commerce announcements, however, we found that risk effects are significant—indeed, more significant than wealth effects.

This work is not without its limitations. First of all, there is subjectivity involved in the identification and characterization of electronic commerce events due to the general vagueness of the announcements, but the challenge of deciphering announcements is shared with other IT event studies in the literature. Another issue is that despite the flexibility of our event study model, we may not have fully accounted for periods of acute market instability during the time frame of our data. Indeed, overcoming these limitations might provide useful directions for further research.

It may also be worthwhile in future research to examine other types of IT-related events where event-induced risk changes might be significant, such as disclosure of piracy or security vulnerabilities, technology-related regulations, and the like. It would also be a useful endeavor to try to better understand what types of IT-related events are risk changers, and what types are not, drawing more deeply on Swanson's (1994) theory of IS innovations. Finally, our results suggest the importance of trying to further understand the drivers of IT riskiness, perhaps through in-depth case and field studies.

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Appendix A. Specification of the Risk-Adjusted Market Model (RMM)

Our RMM model is the multivariate regression model (MVRM) in the literature (see e.g., Binder 1985a) with adjustments for event clustering and event-induced heteroskedasticity. MVRM uses Zellner's (1962) seemingly unrelated regression (SUR) applied to the entire system of returns Equations (4), one for each firm i in the sample of size N:

$$\left.\begin{aligned} R_{1t} &= \alpha_1 + \alpha_1' D_t + \beta_1 R_{mt} + \beta_1' D_t R_{mt} + \gamma_1 D_0 + \varepsilon_{1t} \\ R_{2t} &= \alpha_2 + \alpha_2' D_t + \beta_2 R_{mt} + \beta_2' D_t R_{mt} + \gamma_2 D_0 + \varepsilon_{2t} \\ &\vdots \\ R_{Nt} &= \alpha_N + \alpha_N' D_t + \beta_N R_{mt} + \beta_N' D_t R_{mt} + \gamma_N D_0 + \varepsilon_{Nt}. \end{aligned}\right\} \quad \text{(A1)}$$

Under SUR, the equation residuals are not assumed to be independent across firms, as assumed in MM and MA. Instead, MVRM incorporates the effect of contemporaneous covariance in the estimation of the regression coefficients. The estimation procedure is as follows. The system (A1) can also be expressed as:

$$\begin{bmatrix} R_1 \\ R_2 \\ \vdots \\ R_N \end{bmatrix} = \begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ \vdots & \vdots & & \vdots \\ 0 & 0 & \cdots & X_N \end{bmatrix} \begin{bmatrix} \omega_1 \\ \omega_2 \\ \vdots \\ \omega_N \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_N \end{bmatrix}, \quad \text{(A2)}$$

where

$R_i = T \times 1$ vector of observations on stock return of firm i (over a common calendar-date estimation window for all of the events in the data set);
$X_i = T \times K$ matrix of independent variables;
$\omega_i = K \times 1$ vector of estimated coefficients;
$\varepsilon_i = T \times 1$ vector of residuals;

In matrix form, the system (A2) can be expressed as:

$$\mathbf{R} = \mathbf{X}\boldsymbol{\omega} + \boldsymbol{\varepsilon}. \quad \text{(A3)}$$

The variance-covariance matrix of $\boldsymbol{\varepsilon}$ in (A3) is Ω. By generalized least-squares, a best linear unbiased estimator (BLUE) of $\boldsymbol{\omega}$ in Equation (A3) is given by

$$\mathbf{w}^* = (\mathbf{X}'\Omega^{-1}\mathbf{X})^{-1}\mathbf{X}'\Omega^{-1}\mathbf{R}. \quad \text{(A4)}$$

Because Ω is unknown, the least squares residuals are used to form the estimate of Ω. Due to the event-induced heteroskedasticity, $\hat{\Omega}$ is a $TN \times TN$ block diagonal matrix:

$$\hat{\Omega} = \begin{bmatrix} \hat{\Omega}_1 & 0 & \cdots & 0 \\ 0 & \hat{\Omega}_2 & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \cdots & \hat{\Omega}_T \end{bmatrix}, \quad \text{(A5)}$$

with typical block $N \times N$:

$$\hat{\Omega}_t = \begin{bmatrix} e_{1,t}e_{1,t} & e_{1,t}e_{2,t} & \cdots & e_{1,t}e_{N,t} \\ e_{2,t}e_{1,t} & e_{2,t}e_{2,t} & \cdots & e_{2,t}e_{N,t} \\ \vdots & \vdots & \vdots & \vdots \\ e_{N,t}e_{1,t} & e_{N,t}e_{2,t} & \cdots & e_{N,t}e_{N,t} \end{bmatrix}, \quad \text{(A6)}$$

where $t = 1, 2, \ldots, T$ (calendar-date based estimation window). And the White's heteroskedasticity-consistent estimator (Greene 2000) for the covariance matrix of $\mathbf{w}^*$ is

$$\text{Est. } V(\mathbf{w}^*) = (\tilde{\mathbf{X}}'\tilde{\mathbf{X}})^{-1}\tilde{\mathbf{X}}'\hat{\Omega}\tilde{\mathbf{X}}(\tilde{\mathbf{X}}'\tilde{\mathbf{X}})^{-1}, \tag{A7}$$

where $\tilde{\mathbf{X}}$ is a $TN \times K$ matrix with the first N rows representing the first observation, the next N rows representing the second observation, and so on.

Appendix B. List of Events

No.	Firm	Date	(1)	(2)	(3)
1	America Online Inc. Del	7/1/96	C	D	N
2	Marvel Entertainment Group Inc.	7/1/96	C	D	N
3	Merisel Inc.	7/1/96	B	T	N
4	US West Inc.	7/1/96	B	D	E
5	AT&T Corp.	7/15/96	C	D	N
6	America Online Inc. Del	7/15/96	C	D	E
7	Microsoft Corp.	7/17/96	C	D	N
8	NTN Communications Inc.	7/17/96	C	D	E
9	Tribune Company New	7/17/96	C	D	N
10	Dell Computer Corp.	7/22/96	C	T	N
11	Intel Corp.	7/22/96	B	D	E
12	Tech Data Corp.	7/22/96	B	T	N
13	American Express Co.	7/29/96	B	D	N
14	Microsoft Corp.	7/29/96	B	D	N
15	ITT Industries Inc. Ind	8/1/96	C	D	E
16	Silicon Graphics Inc.	8/6/96	C	D	N
17	True North Communications Inc.	8/6/96	B	D	N
18	20th Century Industries	8/8/96	C	D	E
19	Bell Atlantic Corp.	8/9/96	C	D	N
20	America Online Inc. Del	8/15/96	C	D	N
21	Arbor Software Corp.	8/19/96	B	D	N
22	Bellsouth Corp.	8/27/96	C	D	N
23	America Online Inc. Del	9/4/96	C	D	N
24	American Greetings Corp.	9/4/96	C	T	N
25	International Business Machs Cor.	9/4/96	B	D	N
26	Kroger Company	9/4/96	C	T	U
27	Telescan Inc.	9/6/96	C	D	N
28	AMP Inc.	9/9/96	B	D	E
29	AT&T Corp.	9/9/96	B	D	E
30	Time Warner Inc.	9/10/96	C	D	N
31	Readers Digest Association Inc.	10/1/96	C	D	N
32	US West Inc.	10/1/96	C	D	N
33	Softkey International Inc. New	10/2/96	C	U	N
34	Wave Systems Corp.	10/8/96	B	D	N
35	Checkfree Corp.	10/17/96	B	D	N
36	Dialogic Corp.	10/17/96	C	D	E
37	Cambridge Technology PRTNRS Inc.	10/21/96	B	D	N
38	Yahoo Inc.	10/21/96	C	D	E
39	Unicomp Inc.	10/22/96	B	D	N
40	America Online Inc. Del	10/24/96	C	D	E
41	Sun Microsystems Inc.	10/29/96	B	D	N
42	America Online Inc. Del	11/1/96	B	D	U
43	Microsoft Corp.	11/4/96	C	D	N
44	Yahoo Inc.	11/4/96	C	D	N
45	Symantec Corp.	11/6/96	C	D	E
46	America Online Inc. Del	11/8/96	B	D	E
47	Viacom Inc.	11/11/96	C	D	N
48	Yahoo Inc.	11/11/96	C	D	N
49	Microsoft Corp.	11/12/96	C	D	E
50	Symantec Corp.	11/13/96	C	D	E
51	Diamond Multimedia Systems Inc.	11/14/96	B	D	E
52	Fifth Third Bancorp	11/21/96	C	D	E
53	America Online Inc. Del	11/25/96	B	D	E
54	MCN Corp.	11/25/96	C	D	N
55	Microsoft Corp.	11/25/96	B	D	N
56	US Robotics Corp.	11/25/96	C	D	N
57	McGraw Hill Cos Inc.	11/26/96	B	D	U
58	CMG Information Services Inc.	12/2/96	B	D	N
59	United States Bancorp	12/2/96	C	D	E
60	America Online Inc. Del	12/10/96	B	D	E
61	International Business Machs Cor.	12/10/96	B	D	E
62	Linear Technology Corp.	12/10/96	B	D	N
63	Lycos Inc.	12/11/96	C	D	N
64	PNC Bank Corp.	12/11/96	C	D	N
65	Verifone Inc.	12/11/96	B	D	N
66	America Online Inc. Del	12/16/96	C	T	N
67	Cablevision Systems Corp.	12/17/96	C	D	E
68	CDNOW Inc.	10/1/98	C	D	E
69	Microsoft Corp.	10/1/98	C	D	E
70	New York Times Co.	10/1/98	B	D	N
71	Synergy Brands Inc.	10/1/98	U	U	E
72	Telescan Inc.	10/1/98	B	D	N
73	Andrew Corp.	10/5/98	C	D	N
74	Barnes & Noble Inc.	10/6/98	C	T	N
75	Preview Travel Inc.	10/6/98	C	T	E
76	Programmers Paradise Inc.	10/6/98	B	D	N
77	America Online Inc. Del	10/7/98	C	D	N
78	Microsoft Corp.	10/7/98	C	D	E
79	Networks Associates Inc.	10/7/98	B	D	N
80	Realnetworks Inc.	10/7/98	B	D	E
81	Teleglobe Inc.	10/8/98	B	D	N
82	AT&T Corp.	10/9/98	B	D	E
83	Banta Corp.	10/12/98	B	D	N
84	Sun Microsystems Inc.	10/12/98	B	D	E
85	News Corp. LTD	10/13/98	C	D	E
86	CMP Media Inc.	10/14/98	B	D	N
87	CDNOW Inc.	10/14/98	C	D	N
88	Microsoft Corp.	10/14/98	C	D	E
89	Virtualfund COM Inc.	10/14/98	B	D	N
90	Connect Inc.	10/16/98	B	D	N
91	Digital Courier Technologies Inc.	10/16/98	C	T	N
92	En Pointe Technologies Inc.	10/16/98	B	D	E
93	PC Connection Inc.	10/16/98	C	T	E
94	America Online Inc. Del	10/19/98	B	D	E
95	Fleet Financial Group Inc. New	10/19/98	C	D	N
96	KTEL International Inc.	10/19/98	B	T	E
97	Audio Book Club Inc.	10/20/98	C	T	N
98	Didax Inc.	10/20/98	C	D	E
99	PC Quote Inc.	10/20/98	C	D	E
100	Unionbancal Corp.	10/20/98	C	D	N
101	Data Transmission Network Corp.	10/21/98	B	D	N
102	Nordstrom Inc.	10/21/98	C	T	N

Appendix B (cont'd.)

No.	Firm	Date	(1)	(2)	(3)
103	Microsoft Corp.	10/22/98	C	D	E
104	Online Systems Services Inc.	10/22/98	C	D	E
105	Sabre Group Holdings Inc.	10/26/98	B	D	N
106	Teligent Inc.	10/27/98	B	D	N
107	Sterling Commerce Inc.	10/28/98	B	D	E
108	US West Inc. New	10/28/98	C	D	N
109	AT&T Corp.	10/29/98	C	D	N
110	Online Systems Services Inc.	10/29/98	B	D	N
111	America Online Inc. Del	11/2/98	B	D	E
112	Centura Software Corp.	11/2/98	B	D	N
113	Excite Inc.	11/2/98	C	T	N
114	First Data Corp.	11/2/98	B	D	N
115	Hanover Direct Inc.	11/2/98	B	D	N
116	Infoseek Corp.	11/2/98	C	D	N
117	Micron Electronics Inc.	11/2/98	B	T	N
118	Realnetworks Inc.	11/2/98	C	D	N
119	Yahoo Inc.	11/2/98	C	D	N
120	Gateway 2000 Inc.	11/3/98	C	T	N
121	GAP Inc.	11/4/98	C	T	N
122	Microsoft Corp.	11/4/98	B	D	E
123	America Online Inc. Del	11/5/98	C	D	N
124	Treev Inc.	11/5/98	B	D	N
125	AT&T Corp.	11/9/98	C	D	E
126	Excite Inc.	11/9/98	C	U	E
127	Flexiinternational Software Inc.	11/9/98	B	D	U
128	Hasbro Inc.	11/9/98	C	T	N
129	Merrill Lynch & Co. Inc.	11/9/98	C	D	N
130	Networks Associates Inc.	11/9/98	B	D	N
131	Office Depot Inc.	11/9/98	B	T	N
132	Onsale Inc.	11/9/98	B	T	N
133	Trans World Entertainment Corp.	11/9/98	C	D	N
134	Bank One Corp.	11/11/98	C	D	N
135	Compaq Computer Corp.	11/11/98	C	T	E
136	Intuit Inc.	11/11/98	C	D	N
137	Microsoft Corp.	11/11/98	B	D	N
138	GT Interactive Software Corp.	11/12/98	C	D	N
139	McGraw Hill Cos Inc.	11/12/98	C	D	N
140	Micros Systems Inc.	11/12/98	B	U	N
141	Modacad Inc.	11/12/98	B	D	N
142	Winstar Communications Inc.	11/12/98	C	D	N
143	Handleman Co.	11/16/98	C	T	N
144	Kmart Corp.	11/16/98	C	T	E
145	Lycos Inc.	11/16/98	B	D	N
146	Mathsoft Inc.	11/16/98	C	D	N
147	Barnes & Noble Inc.	11/17/98	B	D	E
148	ETrade Group Inc.	11/17/98	C	D	N
149	Mysoftware Company	11/17/98	B	D	N
150	Staples Inc.	11/17/98	B	T	N
151	Yahoo Inc.	11/17/98	C	T	N
152	AT&T Corp.	11/18/98	C	D	N
153	America Online Inc. Del	11/18/98	B	D	N
154	Sabre Group Holdings Inc.	11/18/98	C	D	E
155	Wild Oats Markets Inc.	11/18/98	C	T	N
156	Ameritrade Holding Corp.	11/19/98	C	D	N
157	Best Buy Company Inc.	11/19/98	C	T	N
158	Merrill Lynch & Co. Inc.	11/19/98	B	D	N
159	National Media Corp.	11/23/98	U	T	N
160	Northern Telecom Ltd.	11/23/98	B	T	N
161	Oracle Corp.	11/23/98	B	T	N
162	Verio Inc.	11/23/98	B	D	N
163	Bank One Corp.	11/24/98	C	D	N
164	Navidec Inc.	11/24/98	B	D	N
165	Net Bank Inc.	11/24/98	C	D	E
166	Irwin Naturals 4 Health Inc.	11/25/98	C	D	N
167	THQ Inc.	11/25/98	C	D	E
168	Fourth Shift Corp.	11/30/98	B	D	N
169	Onhealth Network Company	11/30/98	C	D	N
170	Onsale Inc.	11/30/98	C	T	E
171	Open Market Inc.	11/30/98	B	D	N
172	Amazon Com Inc.	12/1/98	C	D	N
173	Doubleclick Inc.	12/1/98	B	D	N
174	NCR Corp. New	12/1/98	C	D	N
175	Officemax Inc.	12/1/98	C	T	E
176	Wavephore Inc.	12/1/98	B	D	N
177	Xceed Inc.	12/1/98	B	D	N
178	National Record Mart Inc.	12/2/98	C	T	N
179	BIG Entertainment Inc.	12/3/98	C	T	U
180	ETrade Group Inc.	12/3/98	C	D	N
181	Madden Steven Ltd.	12/3/98	C	T	E
182	Yahoo Inc.	12/3/98	C	D	N
183	Fidelity National Financial Inc.	12/4/98	C	T	N
184	Marketing Services Group Inc.	12/4/98	B	T	N
185	Modacad Inc.	12/7/98	C	D	U
186	Multiple Zones International Inc.	12/7/98	C	D	N
187	Newstar Media Inc.	12/7/98	C	D	N
188	Reliance Group Holdings Inc.	12/7/98	C	D	E
189	4Front Technologies Inc.	12/8/98	B	D	N
190	Audio Book Club Inc.	12/8/98	C	D	N
191	Bank One Corp.	12/8/98	C	D	N
192	ETrade Group Inc.	12/8/98	C	D	E
193	Hartford Financial Svcs Group Inc.	12/8/98	C	D	N
194	Amazon COM Inc.	12/9/98	C	D	N
195	Cybershop International Inc.	12/9/98	C	D	N
196	USWeb Corp.	12/9/98	B	D	E
197	Metrocall Inc.	12/10/98	C	D	N
198	Yahoo Inc.	12/10/98	B	D	N
199	Bank One Corp.	12/11/98	C	D	E
200	Sabre Group Holdings Inc.	12/11/98	C	D	E
201	America Online Inc. Del	12/15/98	C	D	N
202	ETrade Group Inc.	12/15/98	C	D	N
203	Network Event Theater Inc.	12/15/98	B	D	E
204	Network Solutions Inc.	12/15/98	B	D	N
205	Sirco International Corp.	12/15/98	C	T	N
206	Tech Data Corp.	12/15/98	B	D	E
207	Yahoo Inc.	12/15/98	B	D	N
208	Amazon COM Inc.	12/16/98	C	T	N
209	Mindspring Enterprises Inc.	12/16/98	B	D	N
210	National Record Mart Inc.	12/16/98	C	D	N
211	AT&T Corp.	12/17/98	C	D	N
212	Audio Book Club Inc.	12/17/98	C	D	E
213	Dell Computer Corp.	12/21/98	C	T	E
214	First American Financial Corp.	12/21/98	C	D	E
215	National Record Mart Inc.	12/21/98	C	D	E
216	Synergy Brands Inc.	12/22/98	C	T	E

Appendix B (cont'd.)

No.	Firm	Date	(1)	(2)	(3)
217	Delia S Inc.	12/24/98	C	T	N
218	Diplomat Corp.	12/30/98	C	U	U
219	Big Entertainment Inc.	12/31/98	B	D	U
220	Bank Of America Corp.	10/2/00	B	D	N
221	ETrade Group Inc.	10/2/00	C	D	E
222	Eresource Capital Group Inc.	10/2/00	C	D	E
223	National Instruments Corp.	10/2/00	C	D	N
224	New York Times Co.	10/2/00	C	D	E
225	Oracle Corp.	10/2/00	B	D	N
226	Robert Half International Inc.	10/2/00	C	D	N
227	Starwood Hotels & Rest Wldwd Inc.	10/2/00	C	T	N
228	State Street Corp.	10/2/00	B	D	N
229	TMP Worldwide Inc.	10/2/00	C	D	E
230	Varian Semiconductor EQP Assc In.	10/2/00	B	T	N
231	Zixit Corp.	10/2/00	B	D	N
232	Ameritrade Holding Corp.	10/3/00	B	D	E
233	Fairchild Semiconductor Intl Inc.	10/3/00	B	D	N
234	Globalnet Financial Com Inc.	10/3/00	C	D	E
235	Netzero Inc.	10/3/00	C	D	N
236	Sprint Corp.	10/3/00	C	D	E
237	America Online Inc. Del	10/4/00	C	D	E
238	Data Broadcasting Corp.	10/4/00	B	D	N
239	Ebay Inc.	10/4/00	C	D	E
240	Homestore Com Inc.	10/4/00	C	D	E
241	Invacare Corp.	10/4/00	C	D	N
242	MBIA Inc.	10/4/00	B	D	E
243	Electronic Arts Inc.	10/5/00	C	D	N
244	Fashionmall Com Inc.	10/5/00	C	D	E
245	Via Net Works Inc.	10/5/00	B	U	E
246	Service Corp. International	10/6/00	C	U	E
247	Carpenter Technology Corp.	10/9/00	B	T	N
248	First Data Corp.	10/9/00	B	D	N
249	Equifax Inc.	10/10/00	B	D	N
250	Eresource Capital Group Inc.	10/10/00	B	D	U
251	Gigamedia Limited	10/10/00	C	D	N
252	Headhunter Net Inc.	10/10/00	B	D	E
253	Ticketmaster Online Citysrch Inc.	10/11/00	C	D	E
254	Via Net Works Inc.	10/11/00	B	D	E
255	CNET Networks Inc.	10/12/00	B	D	E
256	Clarus Corp. Del	10/12/00	B	D	N
257	Landamerica Financial Group Inc.	10/12/00	B	D	N
258	Ethan Allen Interiors Inc.	10/13/00	C	T	E
259	American Express Co.	10/16/00	B	D	N
260	Chase Manhattan Corp. New	10/16/00	C	D	N
261	Epicedge Inc.	10/16/00	C	D	N
262	Headhunter Net Inc.	10/16/00	C	D	N
263	Infospace Inc.	10/16/00	B	D	N
264	Matrixone Inc.	10/16/00	B	D	N
265	Net Bank Inc.	10/16/00	C	D	E
266	Edgar Online Inc.	10/17/00	B	D	E
267	Verisign Inc.	10/17/00	B	D	E
268	Buy Com Inc.	10/18/00	C	T	N
269	Meta Group Inc.	10/18/00	B	D	N
270	AT Home Corporation	10/19/00	C	D	N
271	Radioshack Corp.	10/19/00	C	D	N
272	Sprint Corp.	10/19/00	C	D	N
273	Yahoo Inc.	10/19/00	C	D	N
274	Sports Authority Inc.	10/20/00	C	T	E
275	Verizon Communications	10/20/00	C	D	N
276	Banco Santander Central Hisp. SA	10/23/00	C	D	N
277	CIGNA Corp.	10/23/00	C	D	E
278	Digimarc Corp.	10/23/00	B	D	N
279	Doubleclick Inc.	10/23/00	B	D	E
280	ETrade Group Inc.	10/23/00	C	D	N
281	Hotjobs Com Ltd.	10/23/00	C	D	N
282	Mypoints Com Inc.	10/23/00	C	D	N
283	Sprint Corp.	10/23/00	C	D	N
284	Buy Com Inc.	10/24/00	C	T	N
285	Countrywide Credit Inds Inc.	10/24/00	C	D	N
286	Goto Com Inc.	10/24/00	B	D	N
287	Symantec Corp.	10/24/00	C	D	E
288	TMP Worldwide Inc.	10/24/00	C	D	N
289	Cable & Wireless PLC	10/25/00	B	D	N
290	China Broadband Corp. Ltd	10/25/00	C	D	N
291	Fleetboston Financial Corp.	10/25/00	B	D	N
292	Globix Corp.	10/25/00	B	D	N
293	International Business Machs Cor	10/25/00	B	D	N
294	Microsoft Corp.	10/25/00	C	D	E
295	Pitney Bowes Inc.	10/25/00	B	D	N
296	Compaq Computer Corp.	10/26/00	C	T	E
297	Indus International Inc.	10/26/00	B	D	N
298	Internet Com Corp.	10/26/00	B	D	N
299	MSC Industrial Direct Inc.	10/26/00	B	T	N
300	Polaris Industries Inc.	10/26/00	C	T	N
301	Qwest Communications Intl Inc.	10/26/00	B	D	N
302	Spherion Corp.	10/26/00	U	D	N
303	Acclaim Entertainment Inc.	10/30/00	C	U	N
304	Autobytel Com Inc.	10/30/00	C	T	N
305	BE Free Inc.	10/30/00	B	D	N
306	Buy Com Inc.	10/30/00	C	T	N
307	Countrywide Credit Inds Inc.	10/30/00	C	D	E
308	ESIM Ltd.	10/30/00	C	D	N
309	Ebay Inc.	10/30/00	C	T	N
310	Ebix Com Inc.	10/30/00	B	D	N
311	Netobjects Inc.	10/30/00	B	D	N
312	Oracle Corp.	10/30/00	B	D	N
313	QXL Com Inc.	10/30/00	C	T	N
314	Satyam Infoway Ltd.	10/30/00	B	D	N
315	Switchboard Inc.	10/30/00	U	D	E
316	Citigroup Inc.	10/31/00	C	D	N
317	McGraw Hill Cos Inc.	10/31/00	B	D	N
318	Modem Media Inc.	10/31/00	C	T	N
319	Razorfish Inc.	10/31/00	B	D	N
320	Schwab Charles Corp. New	10/31/00	C	D	N
321	STET Hellas Telecom SA	10/31/00	C	T	U
322	Yahoo Inc.	10/31/00	C	D	E
323	America Online Inc. Del	11/1/00	C	D	N
324	Dow Jones & Co. Inc.	11/1/00	B	D	N
325	Nextel Communications Inc.	11/1/00	B	D	N
326	Target Corp.	11/1/00	C	T	E
327	Ameritrade Holding Corp.	11/2/00	C	D	N
328	Delphi Automotive Systems Corp.	11/2/00	B	D	N
329	Entrust Technologies Inc.	11/2/00	B	D	N
330	First Data Corp.	11/2/00	B	D	N

Appendix B (cont'd.)

No.	Firm	Date	(1)	(2)	(3)
331	TMP Worldwide Inc.	11/2/00	B	D	N
332	Emerge Interactive Inc.	11/6/00	B	D	N
333	Genuine Parts Co.	11/6/00	B	T	N
334	Globalnet Financial Com Inc.	11/6/00	C	D	N
335	Russell Corp.	11/6/00	C	T	N
336	Sprint Corp.	11/6/00	C	D	N
337	Wolverine World Wide Inc.	11/6/00	B	D	N
338	Cybersource Corp.	11/7/00	B	D	N
339	Lions Gate Entertainment Corp.	11/9/00	C	D	N
340	Sprint Corp.	11/9/00	C	D	N
341	TD Waterhouse Group Inc.	11/9/00	C	D	N
342	Electronic Arts Inc.	11/10/00	C	D	E
343	Frontier Airlines Inc. New	11/10/00	B	D	N
344	Lendingtree Inc.	11/10/00	B	D	N
345	Webvan Group Inc.	11/10/00	C	T	E
346	724 Solutions Inc.	11/13/00	B	D	N
347	BID Com International Inc.	11/13/00	C	T	N
348	Citigroup Inc.	11/13/00	C	D	N
349	Com21 Inc.	11/13/00	C	D	N
350	Emusic Com Inc.	11/13/00	C	T	N
351	Juno Online Services Inc.	11/13/00	C	T	N
352	Motorola Inc.	11/13/00	C	T	N
353	Network Commerce Inc.	11/13/00	B	D	N
354	Anntaylor Stores Corp.	11/14/00	C	T	N
355	Bally Total Fitness Holding Corp.	11/14/00	C	T	N
356	Bank Of America Corp.	11/14/00	C	D	U
357	Launch Media Inc.	11/14/00	C	D	N
358	Oracle Corp.	11/14/00	B	D	N
359	SKECHERS USA Inc.	11/14/00	C	T	E
360	AT Home Corporation	11/15/00	C	D	N
361	Zamba Corp.	11/15/00	B	D	U
362	Boise Cascade Corp.	11/17/00	C	D	N
363	Alloy Online Inc.	11/20/00	C	D	E
364	Broadvision Inc.	11/20/00	B	D	N
365	Ebay Inc.	11/20/00	B	D	N
366	Ameritrade Holding Corp.	11/21/00	C	D	E
367	Barnes & Noble Inc.	11/21/00	C	T	N
368	General Electric Co.	11/21/00	C	D	E
369	Good Guys Inc.	11/21/00	C	T	N
370	Goto Com Inc.	11/21/00	B	D	N
371	Telescan Inc.	11/21/00	C	D	N
372	Carpenter Technology Corp.	11/27/00	B	D	N
373	Internet Initiative Japan Inc.	11/27/00	B	D	N
374	Microsoft Corp.	11/27/00	C	D	N
375	Systemax Inc.	11/27/00	C	T	E
376	Amazon Com Inc.	11/28/00	C	T	N
377	Barnesandnoble Com Inc.	11/28/00	C	D	N
378	Office Depot Inc.	11/28/00	B	T	N
379	SBC Communications Inc.	11/28/00	C	D	N
380	Sprint Corp.	11/28/00	B	D	N
381	National City Corp.	11/29/00	C	D	N
382	Realnetworks Inc.	11/29/00	B	D	N
383	Wells Fargo & Co. New	11/29/00	C	D	N
384	West Marine Inc.	11/29/00	C	D	N
385	Network Commerce Inc.	11/30/00	B	D	E
386	Perusahaan PPPT Indo Sat Corp.	11/30/00	B	D	N
387	Sina Com	11/30/00	C	D	N
388	TMP Worldwide Inc.	12/1/00	C	D	E
389	Alltel Corp.	12/4/00	C	D	E
390	Edison Schools Inc.	12/4/00	B	D	N
391	Gartner Group Inc. New	12/4/00	B	D	N
392	Ivillage Inc.	12/4/00	C	D	N
393	Juno Online Services Inc.	12/4/00	B	D	N
394	Ryder Systems Inc.	12/4/00	C	D	N
395	True North Communications Inc.	12/4/00	B	D	N
396	CMGI Inc.	12/5/00	B	D	N
397	Microsoft Corp.	12/5/00	C	D	E
398	American Power Conversion Corp.	12/6/00	B	D	N
399	TMP Worldwide Inc.	12/6/00	C	D	N
400	Verizon Communications	12/6/00	C	D	E
401	Yahoo Inc.	12/7/00	C	D	E
402	Fairmarket Inc.	12/11/00	B	D	E
403	Wells Fargo & Co. New	12/11/00	C	D	E
404	Franklin Resources Inc.	12/12/00	B	T	E
405	Mypoints Com Inc.	12/12/00	B	D	N
406	Russell Corp.	12/12/00	C	T	N
407	Books A Million Inc.	12/13/00	C	D	E
408	Grupo Elektra SA De CV	12/13/00	C	T	E
409	Medicalogic Medscape Inc.	12/13/00	C	D	N
410	Miller Herman Inc.	12/13/00	B	T	N
411	Netzero Inc.	12/13/00	B	D	N
412	Register Com Inc.	12/13/00	B	D	E
413	Satyam Infoway Ltd.	12/13/00	C	D	N
414	Viacom Inc.	12/13/00	C	D	E
415	Dell Computer Corp.	12/14/00	C	T	N
416	Level 3 Communications Inc.	12/14/00	C	D	N
417	Liquid Audio Inc.	12/14/00	C	T	N
418	Martha Stewart Lvng Omnimedia Inc.	12/14/00	C	T	E
419	Panja Inc.	12/14/00	B	T	E
420	Verticalnet Inc.	12/14/00	B	D	N
421	Entrust Technologies Inc.	12/15/00	C	D	N
422	Globalnet Financial Com Inc.	12/15/00	C	D	N
423	Hotjobs Com Ltd.	12/18/00	B	D	N
424	Rediff Com India Ltd	12/18/00	B	D	N
425	America Online Inc. Del	12/19/00	B	D	E
426	Bank One Corp.	12/19/00	C	D	E
427	Viacom Inc.	12/19/00	C	D	N
428	Looksmart Ltd	12/20/00	C	D	N
429	Merrill Lynch & Co. Inc.	12/20/00	B	D	E
430	Zebra Technologies Corp.	12/20/00	B	D	N
431	Boston Communication Group Inc.	12/21/00	C	T	N
432	Broadwing Inc.	12/21/00	C	T	N
433	Colgate Palmolive Co.	12/26/00	C	D	E
434	Partner Communications Co. Ltd	12/26/00	C	D	N
435	New York Times Co.	1/2/02	C	D	E
436	Northwest Airlines Corp.	1/2/02	C	D	E
437	Continental Airlines Inc.	1/3/02	C	T	N
438	Yahoo Inc.	1/7/02	C	D	N
439	Timken Company	1/8/02	B	T	N
440	Proquest Co.	1/14/02	B	D	N
441	Safeway Inc.	1/14/02	C	T	N
442	Bio Reference Laboratories Inc.	1/17/02	C	D	N
443	Wells Fargo & Co. New	1/17/02	C	T	N

Appendix B (cont'd.)

No.	Firm	Date	(1)	(2)	(3)
444	Ebay Inc.	1/21/02	C	T	E
445	AOL Time Warner Inc.	1/23/02	C	D	N
446	Earthlink Inc.	1/23/02	C	D	N
447	Disney Walt Co.	1/29/02	C	D	N
448	Dow Jones & Co. Inc.	1/29/02	C	D	E
449	Ebay Inc.	1/30/02	C	T	E
450	Traffix Inc.	1/30/02	C	D	N
451	AT&T Wireless Svcs Inc.	1/31/02	C	D	N
452	Cigna Corp.	2/4/02	C	D	N
453	Kellogg Co.	2/4/02	C	D	N
454	Terra Networks SA	2/4/02	C	D	N
455	Yahoo Inc.	2/4/02	B	D	N
456	Office Depot Inc.	2/5/02	B	T	N
457	Albertsons Inc.	2/6/02	C	T	E
458	Burlington Northern Santa Fe CP	2/11/02	B	D	E
459	UBS AG	2/11/02	C	T	N
460	AOL Time Warner Inc.	2/15/02	B	D	N
461	Cendant Corp.	2/19/02	C	D	E
462	Office DEPOT Inc.	2/19/02	C	T	E
463	Comcast Corp.	2/25/02	B	D	E
464	Symantec Corp.	2/25/02	B	D	E
465	Valuevision Media Inc.	2/25/02	C	T	N
466	Whitney Holding Corp.	2/25/02	B	D	E
467	Earthlink Inc.	2/26/02	C	D	E
468	Overture Services Inc.	2/28/02	C	D	E
469	Albertsons Inc.	3/4/02	C	T	E
470	AXA UAP	3/5/02	B	D	N
471	Best Buy Company Inc.	3/5/02	C	T	N
472	Tivo Inc.	3/5/02	C	T	N
473	AOL Time Warner Inc.	3/6/02	C	D	E
474	FOX Entertainment Group Inc.	3/6/02	C	D	N
475	Yahoo Inc.	3/6/02	C	D	N
476	Verizon Communications	3/7/02	B	D	E
477	Scholastic Corp.	3/11/02	C	T	E
478	Firstmerit Corp.	3/12/02	C	D	E
479	Safeway Inc.	3/13/02	C	T	E
480	Broadvision Inc.	3/19/02	B	D	N
481	American Eagle Outfitters Inc. Ne	3/20/02	C	D	E
482	SLM Corp.	3/25/02	C	D	E
483	Wells Fargo & Co. New	3/25/02	B	D	E
484	Infosys Technologies Ltd.	3/26/02	B	D	N
485	Ebay Inc.	3/27/02	B	D	N
486	Bellsouth Corp.	3/28/02	C	D	E
487	Sun Life Finl Svcs Cda Inc.	4/2/02	C	D	E
488	America Online Latin America Inc.	4/3/02	C	D	E
489	Huntington Bancshares Inc.	4/3/02	C	D	E
490	Glatfelter PH Co.	4/4/02	B	T	N
491	Ikon Office Solutions Inc.	4/4/02	B	T	N
492	Progressive Corp. Oh	4/10/02	C	D	E
493	Sprint Corp.	4/10/02	C	D	E
494	Drugstore Com Inc.	4/15/02	C	T	N
495	KPMG consulting Inc.	4/15/02	B	D	N
496	Sina Com	4/15/02	C	D	E
497	Verity Inc.	4/15/02	C	D	N
498	Coca-Cola Co.	4/17/02	B	D	N
499	AOL Time Warner Inc.	4/18/02	C	D	N
500	Yahoo Inc.	4/19/02	C	D	N
501	Best Buy Company Inc.	4/23/02	C	D	E
502	Eloan Inc.	4/23/02	C	D	N
503	New York Times Co.	4/23/02	C	D	E
504	Office Depot Inc.	4/23/02	B	T	N
505	Yahoo Inc.	4/24/02	C	D	N
506	Officemax Inc.	4/25/02	C	D	E
507	Verizon Communications	4/25/02	C	D	E
508	WebMD Corp.	4/25/02	C	D	N
509	Liquid Audio Inc.	4/29/02	C	D	N
510	AOL Time Warner Inc.	4/30/02	C	D	E
511	Forrester Research Inc.	5/1/02	B	D	N
512	Unionbancal Corp.	5/1/02	B	D	N
513	Hotels Com	5/2/02	C	D	N
514	UAL Corp.	5/2/02	C	D	E
515	AT&T Wireless Svcs Inc.	5/6/02	C	D	E
516	Hotels Com	5/6/02	C	D	N
517	Sprint Corp.	5/6/02	B	D	E
518	7 Eleven Inc.	5/7/02	C	T	E
519	Accenture Ltd. Bermuda	5/7/02	C	D	N
520	Chubb Corp.	5/7/02	C	D	N
521	Ikon Office Solutions Inc.	5/9/02	B	D	E
522	PNC Financial Services GRP Inc.	5/9/02	B	D	E
523	Choice Hotels International Inc.	5/13/02	C	D	N
524	Varian Inc.	5/14/02	C	T	N
525	TV Azteca SA De CV	5/20/02	C	D	E
526	Terra Networks SA	5/20/02	C	D	N
527	Barnesandnoble Com Inc.	5/28/02	C	D	E
528	I3 Mobile Inc.	5/28/02	C	T	E
529	Staples Inc.	5/29/02	C	D	E
530	Microsoft Corp.	6/3/02	C	D	E
531	SBC Communications Inc.	6/3/02	C	D	N
532	Terra Networks SA	6/3/02	C	D	E
533	Yahoo Inc.	6/3/02	C	D	N
534	Home Depot Inc.	6/4/02	C	T	N
535	US Bancorp Del	6/5/02	B	D	N
536	Mellon Financial Corp.	6/10/02	C	D	N
537	Administaff Inc.	6/11/02	B	D	N
538	International Business Machs Cor.	6/11/02	B	D	N
539	Terra Networks SA	6/11/02	C	D	E
540	Ebay Inc.	6/17/02	C	T	N
541	Sothebys Holdings Inc.	6/17/02	C	T	N
542	Yahoo Inc.	6/17/02	B	D	E
543	Bank One Corp.	6/18/02	C	D	N
544	Delta Air Lines Inc.	6/19/02	C	D	E
545	Kmart Corp.	6/19/02	C	T	N
546	Wells Fargo & Co. New	6/19/02	C	D	N

Appendix B (cont'd.)

No.	Firm	Date	(1)	(2)	(3)
547	Microsoft Corp.	6/20/02	C	D	N
548	Verizon Communications	6/20/02	C	D	N
549	Citigroup Inc.	6/21/02	C	D	E
550	Amazon Com Inc.	6/24/02	C	D	N
551	Arrow Electronics Inc.	6/24/02	C	D	E
552	Office Depot Inc.	6/24/02	C	T	E
553	Principal Financial Group Inc.	6/24/02	C	D	E
554	Wells Fargo & Co. New	6/26/02	B	D	N
555	Unionbancal Corp.	7/1/02	C	D	E
556	Cross Country Inc.	7/2/02	C	D	N
557	TMP Worldwide Inc.	7/2/02	C	D	N
558	SBC Communications Inc.	7/8/02	C	D	N
559	Sabre Group Holdings Inc.	7/8/02	C	D	E
560	Sprint Corp.	7/8/02	C	D	E
561	Yahoo Inc.	7/8/02	C	D	N
562	Reebok INTERNATIONAL LTD	7/9/02	C	T	N
563	Microsoft Corp.	7/11/02	C	D	N
564	Ticketmaster	7/11/02	C	D	N
565	Expedia Inc.	7/16/02	C	D	N
566	America Online Latin America Inc.	7/23/02	C	D	N
567	Delta Air Lines Inc.	7/23/02	C	D	E
568	Vivendi Universal	7/23/02	C	D	N
569	Ask Jeeves Inc.	7/29/02	C	D	E
570	Hewlett Packard Co.	7/29/02	C	T	E
571	AOL Time Warner Inc.	7/30/02	C	D	E
572	Delta Air Lines Inc.	7/31/02	C	D	E
573	Scholastic Corp.	7/31/02	C	T	N
574	Neoforma Inc.	8/5/02	C	D	E
575	Sprint Corp.	8/5/02	C	D	N
576	Terra Networks SA	8/5/02	C	D	N
577	Wells Fargo & Co. New	8/8/02	B	D	E
578	Terra Networks SA	8/12/02	C	D	E
579	Belo Corp.	8/13/02	C	D	E
580	Ilex Oncology Inc.	8/19/02	C	D	N
581	Microsoft Corp.	8/21/02	C	D	N
582	Saba Software Inc.	8/21/02	C	D	N
583	CNET Networks Inc.	8/23/02	B	D	E
584	Pearson PLC	8/26/02	C	T	N
585	Hoovers Inc.	8/28/02	C	D	E
586	Polyone Corp.	8/29/02	C	D	E
587	Six Continents PLC	8/29/02	C	D	N
588	Verizon Communications	8/29/02	C	D	N
589	Microsoft Corp.	9/5/02	C	D	E
590	AOL Time Warner Inc.	9/6/02	C	D	N
591	Amazon Com Inc.	9/6/02	C	T	N
592	Office Depot Inc.	9/6/02	C	T	N
593	Wells Fargo & Co. New	9/6/02	C	D	N
594	Charter Communications Inc.	9/9/02	C	D	N
595	Southtrust Corp.	9/16/02	C	D	E
596	America West Holdings Corp.	9/18/02	C	D	E
597	Charter One Financial Inc.	9/19/02	C	D	E
598	Expedia Inc.	9/19/02	C	D	E
599	Kos Pharmaceuticals Inc.	9/19/02	C	D	N
600	Yahoo Inc.	9/23/02	C	D	E
601	AOL Time Warner Inc.	9/25/02	C	D	N
602	Verizon Communications	9/25/02	C	D	N
603	Tweeter Home Entrtnmnt Group Inc.	10/1/02	C	D	N
604	Ebay Inc.	10/2/02	C	D	E
605	Playboy Enterprises Inc.	10/3/02	C	D	N
606	Unionbancal Corp.	10/3/02	B	D	E
607	Prudential Financial Inc.	10/7/02	B	D	N
608	Microsoft Corp.	10/8/02	C	D	N
609	AT&T Wireless Svcs Inc.	10/15/02	C	D	N
610	Wal Mart Stores Inc.	10/15/02	C	D	N
611	Verizon Communications	10/16/02	C	D	N
612	Britesmile Inc.	10/17/02	C	D	E
613	Disney Walt Co.	10/24/02	C	D	N
614	Microsoft Corp.	10/24/02	C	D	N
615	New York Times Co.	10/28/02	C	D	N
616	Bank Of America Corp.	10/29/02	C	D	E
617	Lilly Eli & Co.	10/30/02	C	D	N
618	SLM Corp.	10/30/02	C	D	N
619	Microsoft Corp.	11/4/02	C	D	N
620	Amazon Com Inc.	11/7/02	C	T	N
621	GAP Inc.	11/7/02	C	T	N
622	New York Times Co.	11/11/02	C	D	N
623	VERISIGN Inc.	11/11/02	B	D	N
624	Office Depot Inc.	11/12/02	C	T	E
625	Pacific Sunwear of CA Inc.	11/13/02	C	T	E
626	Health Net Inc.	11/14/02	C	D	N
627	AOL Time Warner Inc.	11/18/02	C	D	E
628	Harman Intl Inds Inc. New	11/20/02	C	T	E
629	Aetna Inc. New	11/21/02	C	D	E
630	Sina Com	11/21/02	C	D	N
631	New York Times Co.	11/24/02	C	D	E
632	American Home Mortgage Hldgs Inc.	11/25/02	C	D	N
633	AOL Time Warner Inc.	11/26/02	C	D	N
634	PAYCHEX Inc.	12/4/02	C	D	N
635	Americredit Corp.	12/10/02	C	D	N
636	National City Corp.	12/10/02	C	D	N
637	Yahoo Inc.	12/12/02	C	T	E
638	Nokia Corp.	12/18/02	C	T	N
639	Memberworks Inc.	12/23/02	C	D	N
640	Office Depot Inc.	12/31/02	C	T	E

Notes. (1) = B2C/B2B; (2) = Digital/Tangible; (3) = New/Expansion.

In the B2C/B2B column: C, B, and U indicate B2C, B2B, and unclassified electronic commerce initiatives, respectively.

In the Digital/Tangible column: D, T, and U represent digital goods, tangible goods, and unclassified electronic commerce initiatives, respectively.

In the New/Expansion column: N, E, and U represent new, expansion, and unclassified electronic commerce initiatives, respectively.

Appendix C. Sample Excerpts from Announcements

	Digital	Tangible
New	B2B: *PR Newswire*, July 29, 1996, Monday, 1,161 words, American Express and Microsoft form alliance to provide Internet/Intranet travel services; Industry leaders to develop new system for business travel purchasing, New York.	B2B: *Business Wire*, July 1, 1996, Monday, 930 words, Merisel announces new initiatives in support of its North American electronic commerce strategy; Latin American resellers now place orders via Merisel web site; U.S. resellers receive free ground freight on SELline orders, El Segundo, CA.
	B2C: *PR Newswire*, October 24, 2000, Tuesday, 770 words, Countrywide Insurance Services launches online insurance marketplace, Simi Valley, CA.	B2C: *PR Newswire*, July 22, 1996, Monday, 1,177 words, Dell launches Internet computer store; new on-line tools offer customers unmatched convenience, Austin, Texas.
Expansion	B2B: *Business Wire*, October 12, 1998, Monday, 831 words, Sun Microsystems launches web-based training pilot program for U.S. resellers; Online program reduces "out of office" time; Allows for training on demand, Palo Alto, CA.	B2B: *PR Newswire*, December 14, 2000, Thursday, 445 words, Panja announces e-business enhancements to dealer network support, Dallas, TX.
	B2C: *Business Wire*, January 29, 2002, Tuesday, 1,023 words, the Wall Street Journal Online at WSJ.com announces new design, new features, new content, South Brunswick, NJ.	B2C: *PR Newswire*, November 16, 1998, Monday, 445 words, Kmart launches online music shopping; It expands Kmart's presence on the Internet with e-commerce sites offering consumers a variety of products, Troy, Mich.

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