

Y2K: Myth or Reality?

Luis Garcia-Feijóo
Creighton University

John R. Wingender, Jr.
Creighton University

We examine the valuation effects to Y2K-related announcements. We find that the announcement-day abnormal return is not significantly different from zero for the whole sample. Firms announcing the attainment of a Y2K-related contract, however, experience a statistically significant abnormal return of 0.76 percent on the day of the announcement. In contrast, firms that announce that they are Y2K-ready experience a statistically significant negative abnormal return of -0.36 percent on the announcement day. For these companies, regression analysis reveals that abnormal returns are higher the more a firm spent on fixing or preventing Y2K-related problems. Furthermore, Y2K-ready stocks have outperformed industry peers following the year 2000 both in terms of operating and stock return performance. The evidence suggests that investors understood the severity of the problem and were able to distinguish between companies for which the issue was important and those for which it was not.

Introduction

The Y2K bug was due to a common source code used in computer software. Computer systems routinely were programmed for two-digit year entries to save storage space. Therefore, computers could have read 00 as 1900 and failed to recognize 2000 on January 1, 2000. At one point economist Dr. Edward Yardeni, then chief economist at the Deutches Bank Securities, had a comprehensive website on Y2K effects for the world economy. Dr. Yardeni genuinely was concerned that the Y2K bug seriously would worsen the global economic recession he himself predicted for the year 2000. In addition, the Securities and Exchange Commission required publicly traded companies to report their Y2K compliance in their financial statements. Looking back, however, the millennium bug seems to have been a spectacular non-event.

We investigate investors' expectations on the severity of the problems related to the Y2K glitch. Specifically, we examine stock price reactions around corporate announcements associated with the millennium bug. Additionally, we look at the long-run performance of Y2K-ready firms.

Krishnan and Sriram (2000) investigate if Y2K-related investments have an effect on firm value. They find a positive association between 1997 estimates of Y2K-compliance costs and market value of equity. They do not examine the stock price effect of Y2K-related announcements, however, nor do they look at events beyond 1997. Our sample period of announcements spans the years 1997 to 1999. In addition, we also examine the long-run operating and return performance of Y2K-ready stocks. Y2K announcements can be viewed as related to IT (information technology). Dos Santos, Peffers, and Mauer (1993) use event study methodology to evaluate if the market reacts to the announcements of e-commerce initiatives to investigate if there are long-term benefits to the firm and its shareholders. They report a positive impact from innovative information technology investment announcements on the market value of the firms. They also find excess returns on their full sample. Sriram and Krishnan (2003) find a reaction of companies in the financial services sector to information technology-related disclosures. We expand their research to consider the impact of Y2K technology investment on companies in other industries as well. Denhning and Richardson (2002) compile a comprehensive review of the returns on investment in information technology. They synthesize research on the impact of IT investments on firm value. They start with the productivity paradox, where early studies do not find a positive relation between spending on IT and profitability.

A priori, the stock price reaction to announcements that corporations are using resources to identify and to fix Y2K problems could be positive (for example, Chatterjee, Pacini, and Sambamurthy, 2002), negative (for example, Oh and Kim, 2001), or zero (for example, Tam, 1998). A positive stock price reaction would imply that investors thought the Y2K bug to be a serious threat to a company's operations and therefore that the use of corporate resources to fix the problem was good news. Solving Y2K problems could be good news because either it would imply larger company's cash flows, lower systematic risk, or both. The worries related to the negative impact of the Y2K problems on business directly were associated with potential computer malfunctions. For example, one worry was that customer orders for 2000 would not be filled as the Y2K problem would be looking at 1900 orders, thus leading to lost sales. Another worry was that IT systems would not request material needed for 2000 sales orders. At the other extreme, if investors did not believe the Y2K bug to be a significant problem, the use of corporate resources to fix it could be interpreted as wasteful and hence prompt a negative stock price response at the announcement. Finally, the stock price response could be zero if the

announcement is uninformative, either because it has been anticipated or because it is irrelevant.

We find that the announcement-day abnormal return is not significantly different from zero for the whole sample of events from 1997 through 1999. Firms announcing the attainment of a Y2K-related contract, however, experience an abnormal return of 0.76 percent on the day of the announcement. The abnormal return is significantly different from zero at the 1 percent level. Similarly, providers of technical solutions experience a cumulative abnormal return of 3.57 percent over days (-1, 0), which is significant at the 5 percent level.

Companies that announce that they have entered an alliance to fix Y2K-related problems, companies that announce Y2K-related products, or companies that announce the completion of a Y2K-remediation program experience abnormal returns that are not significantly different from zero at conventional levels.

In contrast, firms that announce that they are Y2K-ready experience a negative abnormal return of -0.36 percent on days (-1, 0) relative to the announcement day. This abnormal return is significantly different from zero at the 5 percent level. For these companies, regression analysis reveals that abnormal returns are higher the more a firm spent on fixing or preventing Y2K-related problems. Long-run performance analysis indicates that Y2K-ready firms have outperformed industry control firms in terms of operating performance and that they have performed similarly to control firms in terms of stock return performance over the period 1999-2003. Y2K-ready firms' long-run stock returns were significantly lower than those of control firms during the first year (1999-2000), however, but higher than those of control firms following the year 2000.

Overall, our results are consistent with the following story. The Y2K glitch was an important corporate event. Stock prices reacted negatively on average to announcement of Y2K readiness news. To the extent that the announcement implied no further preventive work by the announcing firm, investors might have reacted negatively if they still expected problems around the turn of year. Consistent with this, the announcement news conveyed negative intra-industry information. There is evidence, however, that investors were able to go past the mere announcement of Y2K readiness to assess the likelihood of Y2K-related problems. Short-term abnormal returns are larger the more firms invested in fixing possible problems, which indicates that investors saw the spending as efficient investment. Consistent with this, announcing firms have outperformed industry peers both in operating and stock return performance following the year 2000. Thus, investors were able to distinguish between companies for which the issue was important and those for which it was not. Our research provides interesting empirical evidence on the ever-controversial topic of market efficiency.

Sample Description

Our sample of Y2K-related announcements is gathered through a keyword search in the LexisNexis database. The sample period is for the years 1997, 1998, and 1999. Although the initial sample is 533 announcements, only 432 are made by corporations with sufficient return information on CRSP to run an event study. In Table 1, we break down the sample by event type that describes each classification.

Table 1—Description of 432 Y2K-Related Announcements by Event Type

Event	Description	Freq	%
Alliance	Working in Partnership	38	8.8
Contract	Announcing Firm is Awarded Contract	59	13.6
Drill	Successful Completion of Y2K Drill	28	6.5
New Product	Offering New Product, Service, Tool, or Solution	43	9.9
Provided Solution	Provided Solution	22	5.1
Remediation	Completed Remediation Program	18	4.2
Using Solution	Started Using Y2K Solution	9	2.1
Y2K Ready	Y2K Compliant	119	27.5
Other	Other Y2K-related Announcement	96	22.2
	Total	432	100

The events are classified into nine categories. If a company announces that it has formed an alliance with another company to use or to develop a computer software program for remediation of the Y2K problem, the announcement is classified as an “Alliance” (8.8 percent of the sample). If a company announces that it has been awarded a contract to provide Y2K remediation services, the announcement is classified as a “Contract” (13.6 percent). Announcements of new Y2K products for existing solutions, new solutions, or new tools are classified under “New Product” (9.9 percent). If a company providing Y2K solutions announces that it provided its solution to another company, the announcement is classified as “Provided Solution” (5.1 percent). If a company announces that it has completed remediation work, the announcement is classified as “Remediation” (4.2 percent). If a company announces that it is Y2K compliant, the announcement is classified as “Y2K Ready” (27.5 percent). The announcement of a successful completion of a Y2K drill is classified as “Drill” (6.5 percent). Finally, all other announcements are classified as “Other” (22.2 percent). This category includes announcements such as a company is expected to sign a Y2K services contract, but the final contract has not been signed yet; an announcement that a company is working on its computer systems to fix the Y2K problem; or an announcement that a company is offering a training course on how to use its Y2K remediation program.

Table 2 contains a description of the sample segmented by announcement year and by the stock exchange of the announcing firm, excluding the category “Other Y2K-related announcement.” Fifty-five percent of the announcements were made in 1999. The observation shows that a study considering the valuation impacts of Y2K IT investments in 1997, such as that of Krishnan and Sriram (2000), does not contain

a majority of the related events. In addition, fifty-five percent of announcing firms are traded on the NYSE, while forty-two percent trade on NASDAQ.

Table 2—Description of Y2K-Related Announcements by Announcing Year and Listing Exchange of the Announcing Firm

Panel A: Announcing Year				
Event	1997	1998	1999	
Alliance	4	25	9	
Contract	5	48	6	
Drill	-	-	28	
New Product	-	29	14	
Provided Solution	5	13	4	
Remediation	1	9	8	
Using Solution	2	5	2	
Y2K Ready	2	3	114	
	19	132	185	

Panel B: Listing Exchange				
Event	NYSE	AMEX	NQ	Pink Sheet
Alliance	15	-	23	-
Contract	20	2	36	1
Drill	25	-	3	-
New Product	16	-	26	1
Provided Solution	3	-	19	-
Remediation	12	-	6	-
Using Solution	8	-	1	-
Y2k Ready	87	2	26	4
	186	4	140	6

Event-Study Results

We use event-study methods to measure the common stock price reaction to Y2K announcements. Abnormal returns are calculated as the prediction errors from a single-factor market model. Market model parameters are estimated using 250 trading days ending 46 trading days before the announcement date. To test whether the cumulative abnormal return is significantly different from zero, we use the standardized cross-sectional method of Boehmer, Musumeci, and Poulsen (1991), which allows for event-induced variance changes. The test statistic also is adjusted for the serial correlation of abnormal returns within the event window (Mikkelsen and Partch, 1988). We use a two-tailed test to determine significance levels. We use the value-weighted CRSP index as the market index. Although not reported, results are qualitatively similar when we use the equally-weighted CRSP index. Following Cowan, Nayar, and Singh (1990), we also employ a generalized sign test, which differs from the simple sign test in that the fractions of positive and negative returns under the null hypothesis are determined by the fractions observed in the estimation period rather than fixed at 0.5.

Some companies make several announcements of the same type (i.e., alliance). In these cases, we retain the earliest announcement, and we require sufficient return data to perform our event study. These requirements reduce the sample size to 256 announcements. Table 3, Panel A presents the results for the whole sample. The abnormal return on the day of the announcement (0, 0) is -0.04 percent. Both parametric and nonparametric tests cannot reject the hypothesis that the abnormal return is equal to zero. There is some evidence of negative stock returns prior to announcement. The CAR over days $(-10, -2)$ relative to the announcement day is -1.46 percent, which is significant at the 5 percent level (the z -statistic is -2.013).

Table 3, Panel B, shows that stock prices react negatively to the announcement of an alliance. The abnormal return on the announcing day is -1.08 percent. The abnormal return is not significantly different from zero according to either the parametric or nonparametric test, however. Results are similar for the new product subgroup in Table 3, Panel C. The abnormal return of -0.60 percent on the announcing day is not significantly different from zero.

Table 3, Panel D, reports results for the contract categories. Companies announcing that they have been awarded a contract to provide Y2K remediation services experience a positive stock price response of 0.76 percent on the announcement day. This abnormal return is significantly different from zero at the 1 percent level using the generalized sign test. Thus, a contract is viewed as good news, presumably because it is expected to increase cash flows for the company. Additionally, cumulative abnormal returns continue to be positive for at least ten days after the announcement. The average CAR over the period $(1, 10)$ is 3.04 percent, which is statistically significantly positive at the 1 percent level according to the nonparametric test.

Table 3, Panel E, reports results for the provided solution subsample. A company that announces that it has provided its solution to another company experiences a positive abnormal return of 2.23 percent on the announcement day. The parametric test shows that the abnormal return is significant at the 10 percent level. Similarly, the CAR of 3.57 percent over days $(-1, 0)$ is significantly different from zero at the 5 percent level according to the parametric test. Given the small sample size (17 announcements), this result should be viewed with caution.

Table 3, Panel F, displays abnormal returns for firms that complete their remediation work on their Y2K situation. Abnormal returns for the remediation subsample are not statistically significantly different from zero.

Table 3, Panel G, reports abnormal returns for firms that announce that they are compliant or Y2K-ready. The abnormal return on the announcement day is -0.29 percent, which is significantly different from zero at the 10 percent level according to the parametric test. The CAR over days $(-1, 0)$ is also negative, -0.36 percent, and significant at the 5 percent level (the z -statistic is -2.228). Interestingly, the CAR

Table 3—Event-Study Results Around Y2K-Related Announcements

Announcement types are described in Table 1. Market model parameters are estimated using 250 trading days ending 46 trading days before the announcement date. To test whether the cumulative abnormal return is significantly different from zero, we use the standardized cross-sectional method. We use the value-weighted CRSP index. We also employ a generalized sign test, which differs from the simple sign test in that the fractions of positive and negative returns under the null hypothesis are determined by the fractions observed in the estimation period, rather than fixed at 0.5. Significance at the 1 percent, 5 percent, or 10 percent level is shown as ***, **, or *

Event Day	N	CAR	Positive:Negative	Z	Generalized Sign Z
Panel A: All Announcements					
(-10, -2)	256	-1.46	111:145	-2.013**	-1.346
(-1, 0)		-0.14	125:131	-0.789	0.406
(0, 0)		-0.04	131:125	-0.343	1.157
(1, 10)		0.93	136:120	1.179	1.789*
Panel B: Alliance					
(-10, -2)	27	-2.66	12:15	-0.200	-0.246
(-1, 0)		-1.24	13:14	-1.601	0.140
(0, 0)		-1.08	13:14	-1.277	0.140
(1, 10)		0.48	14:13	-0.025	0.526
Panel C: New Product					
(-10, -2)	30	-2.97	14:16	-1.027	0.002
(-1, 0)		-1.15	14:16	-0.127	0.002
(0, 0)		-0.60	13:17	-0.291	-0.364
(1, 10)		3.35	15:15	0.854	0.368
Panel D: Contract					
(-10, -2)	34	-3.34	14:20	-0.966	-0.630
(-1, 0)		-0.22	14:20	-0.076	-0.630
(0, 0)		0.76	25:9	1.614	3.152***
(1, 10)		3.04	22:12	1.479	2.120**
Panel E: Provided Solution					
(-10, -2)	17	-0.54	9:8	-0.474	0.513
(-1, 0)		3.57	11:6	2.101**	1.485
(0, 0)		2.23	10:7	1.756*	0.999
(1, 10)		-0.21	9:8	0.220	0.513
Panel F: Remediation					
(-10, -2)	16	1.87	11:5	1.565	1.692*
(-1, 0)		-1.59	8:8	-1.235	0.190
(0, 0)		-0.75	9:7	-0.848	0.691
(1, 10)		-5.06	5:11	-1.897*	-1.312
Panel G: Y2K Ready					
(-10, -2)	96	-0.56%	42:54	-1.690*	-0.869
(-1, 0)		-0.36	43:53	-2.228**	-0.665
(0, 0)		-0.29	40:56	-1.784*	-1.278
(1, 10)		1.17	56:40	2.132**	1.991**
Panel H: Drill					
(-10, -2)	26	-1.42	-1.64	-2.361**	-2.236**
(-1, 0)		0.66	0.55	1.674*	0.903
(0, 0)		-0.12	0.07	0.258	0.119
(1, 10)		-0.34	-0.68	-0.654	-1.451

over days (1, 10) is 1.17 percent, which is significantly different from zero at the 5 percent level according to both the parametric and nonparametric tests.

Table 3, Panel H, reports results for the drill subsample. There is evidence of negative abnormal returns prior to the announcement. The CAR over days (-10, -2) is -1.42 percent, which is significant at the 5 percent level according to both parametric and nonparametric tests. The announcement-day abnormal return is -0.12 percent, which is not significantly different from zero at conventional levels.

In conclusion, it appears that investors were able to predict the lack of relevance of the Y2K bug, despite considerable alarming news on its expected effects. Firms that made announcements implying higher expected cash flows experienced positive abnormal returns at the announcement. Firms that announced that they were Y2K-ready experienced somewhat negative abnormal returns, which suggests that investors saw Y2K-related expenses as wasteful. In the next section, we explore this issue in more detail.

Y2K-ready: Regression Analysis

In this section, we examine if announcement-day abnormal returns are associated with the amount of cash firms spent to become Y2K compliant, controlling for other factors. Information on the amount of cash spent getting Y2K-ready is taken from annual reports. We were able to find that information for 70 companies.

Table 4, Panel A, shows that firms spent an average (median) of \$49.8 (14.85) million getting Y2K-ready. The average ratio of Y2K-related spending divided by the market value of the equity of the firm as of the fiscal year prior to the announcing year is 0.82 percent. The median ratio is 0.55 percent.

Table 4, Panel B, shows financial information of the announcing firms as of the end of the fiscal year prior to the announcing year. Average (median) total assets are \$16,382 (\$6,172) million, while average (median) sales are \$7,193 (\$1,972) million. The average (median) market value of equity is \$11,357 (\$2,829) million. In terms of profitability, average return on assets is 3.73 percent while average return on equity is 14 percent. Median values are 2.15 percent and 12.65 percent, respectively. The average (median) value of the firms' equity beta is 0.65 (0.53), while the average (median) ratio of total debt divided by market value of equity is 81 percent (68 percent).

The average (median) ratio of the market value of equity divided by the book value of equity is 2.94 (2.28). The average (median) ratio of capital expenditures divided by total assets is 6 percent (5 percent), while mean and median numbers for the ratio of R&D expenses to total assets are 3 percent and 2 percent, respectively. Institutional ownership in announcing firms is low. Only 15 firms report any level of institutional ownership. For these firms, the average and median levels of institutional ownership are 4.45 percent and 3.9 percent, respectively.

Table 4—Financial Characteristics of Firms Announcing that They are Y2K-ready

Spending is the total amount, in millions of dollars, spent on becoming Y2K-ready, from annual reports. Financial information on Panel B corresponds to the end of the fiscal year prior to the announcement year

Panel A: Y2K Spending

	Spending (\$ million)	Spending /MVE
Mean	49.8	0.82%
Max	725	8.22
Q3	34.7	0.93
Med	14.85	0.55
Q1	1.8	0.25
Min	0.00	0.00
N	70	66

Panel B: Financial Characteristics of Announcing Firms

	Mean	Median	N
Total Assets (TA, \$million)	16,381.6	6,171.9	66
Sales (\$million)	7,192.6	1,972.0	65
Market Value Equity (MVE, \$million)	11,357.5	2,829.0	66
Return on Assets (ROA)	3.73%	2.15%	65
Return on Equity (ROE)	14.00%	12.63%	65
Beta	0.65	0.53	65
Total Debt / MVE	0.81	0.68	64
Market-to-Book Equity (MTB)	2.94	2.28	63
Capital Expenditures / TA	0.06	0.05	47
R&D / TA	0.03	0.02	11
Institutional Ownership	4.45%	3.9%	15

Before proceeding with the regression analysis, Table 5 describes the industry affiliation of sample firms in terms of two-digit SIC codes. The industry concentration is in the “Electric, Gas, and Sanitary Services” category (36 percent of the sample), and in the “Depository Institutions” group (33 percent). To control for industry effects in the regression analysis, we classify industry codes into four groups, as shown in Table 5, Panel B. The four industry classifications are “Depository Institutions” (39 percent of sample), “Electric, Gas, and Sanitary Services” (36 percent), “Machinery and Transportation” (11 percent), and “Other” (14 percent).

Table 6 reports regression results relating percent abnormal returns over days (-1, 0) with the total amount (millions of dollars) spent to become Y2K-ready (SPENDING) and several control variables. The regression analysis is performed on a subsample of 63 firms, 62 of which made announcements in 1999. Excluding the only firm that made an announcement in 1998 does not affect reported results.

The first specification includes SPENDING and the log of market value of equity (logMVE). SPENDING is significantly positively associated with abnormal returns at the announcement. The coefficient estimate is 0.007, which is significantly different from zero at the 5 percent level. Size (logMVE) is significantly negatively associated with abnormal returns. Larger firms experience lower abnormal returns at announcement.

Table 5—Industry Affiliation of Firms that Announce that They are Y2K-ready

Industry	SIC	Freq	%
Panel A: Two-digit SIC Codes			
Furniture	25	1	1.43
Printing, Publishing	27	1	1.43
Chemicals	28	1	1.43
Petroleum Refining	29	2	2.86
Heavy Machinery	35	1	1.43
Electric Equipment	36	2	2.86
Transportation Equip,emt	37	1	1.43
Motor Transportation, Warehouse	42	1	1.43
Transportation by Air	45	3	4.29
Communications	48	2	2.86
Electric, Gas, Sanitary Services	49	25	35.71
Depository Institutions	60	23	32.86
Nondepository Credit Institutions	61	1	1.43
Security & Commodity Brokers	62	1	1.43
Insurance	64	1	1.43
Holding, Other Investment	67	1	1.43
Business Services	73	3	4.29
Panel B: Industry Regression Groups			
Depository Institutions	60-62, 64, 67	27	38.57
Electric, Gas, Sanitary Services	49	25	35.71
Machinery & Transportation	35-37, 42, 45	8	11.4
Other	25, 27-29, 48, 73	10	14.29

Results are economically significant. A spending increase of \$20 million (the difference between the median and the third quartile spending) would have resulted in announcing CARs being 14 percent less negative or a 5 percent increase in abnormal returns from the observed -0.36 percent drop at announcement. For the median company, with market value of equity of \$2,829 million, the increase in firm value translates into \$141 million.

The second and third specifications in Table 6 show that results are similar when we control for profitability (ROE) and risk, either using beta or financial leverage. The coefficient estimate for SPENDING is 0.008, which is significantly different from zero at the 1 percent level. Size remains negatively associated with abnormal returns.

The last specification includes ROE, leverage, and market-to-book as a proxy for investment opportunities. Results do not vary. SPENDING is consistently significantly positively associated and logMVE negatively associated with CARs over days $(-1, 0)$. Although not shown, industry dummies are never significant when included in the regressions.

Therefore, although investors react negatively to the announcement of Y2K readiness, abnormal returns are higher the more a company spends in becoming Y2K compliant, controlling for other variables. This result complements that of Anderson, Banker, and Ravindran (2006), who find that the strong positive relation between

shareholder value and Y2K spending persists through the market downturn of 2000-2002. In the next section, we investigate whether event-study methodology supports their long-term conclusions.

Table 6—Regression Results

The regression model is (firm-specific subscripts are omitted):

$$\text{CAR}(-1,0) = \text{Intercept} + b_1 * \text{Spending} + b_2 * \text{Log(MVE)} + b_3 * \text{ROE} + b_4 * \text{Beta (or Leverage)} + b_5 * \text{MTB} + e.$$

where CAR(-1,0) is the cumulative abnormal return over days (-1,0) relative to announcement day for companies that announce that they are Y2K-ready. Spending is the total amount, in millions of dollars, spent on becoming Y2K-ready, from annual reports. MVE is market value of equity, ROE is return on equity, Leverage is the ratio of total debt to MVE, and MTB is the ratio of MVE divided by the book value of equity. Except for SPENDING, variables are measured at the end of the fiscal year prior to the announcement year. Estimates and heteroskedasticity-consistent standard errors (in parenthesis) are in percent

	(1)	(2)	(3)	(4)
Intercept	2.301* (1.341)	2.778* (1.568)	1.571 (1.606)	1.603 (1.584)
SPENDING	0.007** (0.002)	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)
LogMVE	-0.385** (0.189)	-0.525** (0.191)	-0.464** (0.176)	-0.474** (0.178)
ROE		-0.002 (0.043)	0.075* (0.040)	0.071* (0.038)
Beta		0.759* (0.438)		
Leverage			0.395 (0.380)	0.414 (0.380)
MTB				0.024 (0.124)
Adj R2	0.0659	0.1161	0.0841	0.0676
Observations	63	58	60	60
p-value	0.0483	0.0316	0.0650	0.1176

*** significance at the 1 percent level.

** significance at the 5 percent level.

* significance at the 10 percent level

Long-Run Operating and Return Performance

In this section, we look at the long-run performance of firms that announce they are Y2K ready. We start by putting together a control sample following Loughran and Ritter (1997). Specifically, we form a comparison group by matching each sample firm with a control firm by industry (4-digit SIC code), total assets, the ratio of operating income before depreciation and amortization (i.e., EBITDA) to assets, and systematic risk or beta, as of the end of the 1999 fiscal year. We use Compustat to obtain the necessary financial data. To maintain a reasonable size match, the total assets of control firms are required to be between 15 percent and 300 percent of the total assets of sample firms. Additionally, the absolute value of the difference in the ratio of EBITDA to assets between sample and control firms is required to be lower

than 0.25. Among all possible control firms, we select the one with the closest level of systematic risk.

To examine long-run performance, we use two different approaches. First, we examine the operating performance of Y2K-ready firms around 1999. Operating performance is measured by accounting ratios such as profit margin and return on assets, following Loughran and Ritter (1997). We examine operating performance by looking at the evolution of the following variables: Operating income before depreciation and amortization/Assets (EBITDA/TA), Gross Profit Margin (GPM), Return on Assets (ROA), (Capital Expenditures + Research and Development)/Assets (CE+RD/TA). As an additional control for possible risk differences, we also look at the evolution of Total Debt/Assets (TD/TA).

Second, we compute long-run abnormal stock returns by constructing a zero-investment portfolio that is long the Y2K-ready sample firms and short the control group. We discuss the results of each of these in the sections that follow.

Long-Run Operating Performance

Table 7 displays mean values of the ratios that characterize the operating performance of the Y2K-ready firms and their control group. The ratio of EBITDA/TA at the end of the 1999 fiscal year is 10.7 percent for the sample firms and 9.95 percent for the control group. This ratio is used to define the control firms so the two groups should not be significantly different from one another. The t-statistic for the paired-sample mean t-test is 1.01, confirming that the two sample means are not statistically different from each other.

The table shows that both Y2K-ready firms and the control group experience a profitability decline around 1999. The ratio of EBITDA/TA for the sample firms is 10.7 percent in 1999 and decreases monotonically to 9.33 percent in 2002. For the control firms, the ratio is equal to 9.95 percent in 1999 and decreases monotonically to 6.23 percent in 2002. A similar pattern can be observed when profitability is measured using ROA.

The two samples are not statistically significantly different in terms of either EBITDA/TA or ROA in any year prior to the year 2000. Subsequently however, Y2K-ready firms become significantly more profitable than the control group. The average ratio of EBITDA/TA is 9.33 percent in 2002 and 9.80 percent in 2003 for the sample firms and 6.23 percent in 2002 and 6.85 percent in 2003 for the control firms. The averages for both years are significantly different at the 5 percent level. Similarly, the average ROA is 2.65 percent in 2001, 1.93 percent in 2002, and 2.85 percent in 2003 for the sample firms and 0.41 percent in 2001, -2.36 percent in 2002, and 0.63 percent in 2003. The annual averages are significantly different at the 5 percent level. Furthermore, median numbers reported in Table 8 show that a few outliers do not drive the results.

Table 7—Means and Mean-Comparison Tests for the Sample of Y2K-ready Companies and the Control Sample

Fiscal Year	EBITDA/Assets	Gross Profit Margin	Return on Assets	CE + RD/TA	TD/TA	Number of Firms
Panel A: Sample Means						
1995	10.9%	39.0%	3.38%	6.33%	0.29	73
1996	11.2	38.5	3.72	6.42	0.28	73
1997	11.2	38.0	3.32	6.86	0.29	74
1998	10.2	35.2	3.20	7.26	0.30	78
1999	10.7	36.7	3.68	7.21	0.32	84
2000	10.3	33.8	3.37	6.72	0.32	73
2001	9.60	37.1	2.65	6.54	0.34	67
2002	9.33	40.4	1.93	5.94	0.33	63
2003	9.80	40.2	2.85	5.21	0.32	56
Panel B: Control Means						
1995	10.3	34.4	2.78	9.32	0.28	73
1996	10.4	34.0	3.65	7.76	0.27	73
1997	10.5	28.1	3.12	8.10	0.29	74
1998	10.4	31.7	3.44	7.70	0.31	78
1999	9.95	34.0	3.33	7.47	0.32	84
2000	8.60	31.5	2.55	7.35	0.31	73
2001	7.76	30.4	0.41	7.58	0.34	67
2002	6.23	30.8	-2.36	6.27	0.33	63
2003	6.85	34.5	0.63	5.05	0.32	56
Panel C: Paired-sample Mean t-test (t-statistics)						
1995	0.20	1.88	0.42	-2.30	0.84	73
1996	0.46	2.91	0.21	-1.68	0.06	73
1997	0.61	2.85	0.22	-1.43	0.09	74
1998	-0.61	0.54	-0.39	-1.09	-0.75	78
1999	1.01	3.11	0.67	-0.44	0.16	84
2000	1.14	2.15	1.06	-0.88	0.58	73
2001	1.56	2.62	2.34	-1.66	-0.81	67
2002	2.14	3.38	2.28	-0.68	-0.05	63
2003	2.18	2.49	2.06	0.32	0.29	56

Table 7 also reports average gross profit margin for sample and control firms. Sample firms are consistently more profitable than the control group for the eight years surrounding the reference year, 1999. Although this contrasts with the evidence from EBITDA/TA and ROA, it is possible that GPM is not an appropriate measure of profitability for some industries (Table 5).

In addition to operating performance, we measure the investment activities of the sample firms as the ratio of the sum of capital expenditures and research and development expenses to total assets. We measure financial leverage as the ratio of total debt to total assets. The remaining results in Table 7 show that Y2K-ready firms and industry peers are statistically indistinguishable from each other in terms of investment activity (CE+RD/TA) or debt financing (TD/TA) for the eight years

surrounding the year 1999. As mentioned, we also test for differences using medians and reach the same conclusions.

Table 8—Medians and Distribution-Comparison Tests for the Sample of Y2K-ready Companies and the Control Sample.

Fiscal Year	EBITDA/Assets	Gross Profit Margin	Return on Assets	CE + RD/TA	TD/TA	Number of Firms
Panel A: Sample Medians						
1995	11.2%	38.4%	2.84%	5.18%	0.33	73
1996	11.6	35.7	3.18	4.75	0.31	73
1997	11.1	34.1	2.70	5.47	0.30	74
1998	10.9	33.6	2.70	6.46	0.31	78
1999	10.0	33.2	2.51	6.45	0.35	84
2000	9.29	30.5	2.29	6.19	0.35	73
2001	8.80	34.2	1.79	5.98	0.35	67
2002	7.94	35.0	1.84	5.84	0.36	63
2003	8.93	32.9	1.91	4.52	0.33	56
Panel B: Control Medians						
1995	11.5	32.9	3.06	6.16	0.33	73
1996	11.0	33.1	3.20	6.16	0.32	73
1997	11.1	31.7	3.39	6.19	0.33	74
1998	10.6	30.2	3.29	6.31	0.34	78
1999	9.94	31.9	3.24	6.00	0.35	84
2000	8.79	27.9	2.10	5.28	0.33	73
2001	7.75	24.7	1.57	6.42	0.39	67
2002	7.44	25.7	1.39	5.72	0.37	63
2003	7.06	24.0	1.56	4.93	0.33	56
Panel C: Wilcoxon Matched-Pairs Sign-Ranks Test (z-statistics)						
1995	-0.19	2.28	-0.56	-1.74	0.91	73
1996	1.46	2.57	-0.90	-1.67	-0.02	73
1997	0.79	2.62	-0.16	-1.35	-0.23	74
1998	0.72	2.16	-0.66	0.70	-0.73	78
1999	0.43	2.83	0.29	0.86	0.06	84
2000	0.77	1.78	0.44	0.98	0.19	73
2001	1.62	2.42	2.17	-1.57	-0.39	67
2002	2.12	3.04	2.56	1.12	-0.45	63
2003	2.94	2.33	2.54	-0.06	-0.39	56

Therefore, there is evidence that Y2K-ready firms become more profitable than industry peers following the year 2000. This is consistent with Y2K-ready firms increasing their productivity levels following the year 2000, perhaps by having made good investments in technology around the Y2K bug event.

Long-Run Return Performance

For completeness, we begin by examining the intra-industry price effects of the Y2K-readiness announcement by sample firms. We compute cumulative abnormal returns as above. In particular, abnormal returns are calculated as the prediction

errors from a single-factor market model. Market model parameters are estimated using 250 trading days ending 46 trading days before the announcement date. To test whether the cumulative abnormal return is significantly different from zero, we use the standardized cross-sectional method of Boehmer, Musumeci, and Poulsen (1991) and the generalized sign test (Cowan, Nayar, and Singh, 1990). We use a two-tailed test to determine significance levels. We use the value-weighted CRSP index as the market index.

Table 9, Panel A shows that industry peers experience a cumulative abnormal return of -0.55 percent over days (-1, 0) relative to the announcement day. This abnormal return is significantly different from zero at the 5 percent level using the parametric test, and at the 10 percent level using the generalized sign test. By comparison, the CAR over days (-1, 0) for the announcing firms is -0.48 percent, which is significantly different from zero at the 5 percent level using the parametric test.¹ Furthermore, there is no evidence of price effects either before or after the announcement date for control firms.

Table 9—Abnormal Returns for the Y2K-ready Sample and the Control Sample

Panel A: Short-term Cumulative Abnormal Returns					
Return Group	Date	CAR	Z	Pos:Neg	Gen Sign
Sample Firms 83	(-10, -2)	-1.00%	-2.091**	32:51	-1.770*
	(-1, 0)	-0.48	-2.541**	35:48	-1.111
	(1, 10)	1.20%	1.307	49:34	1.964**
	(-10, -2)	0.19	0.211	42:41	0.610
Control Firms 83	(-1, 0)	-0.55	-2.359**	31:52	-1.821*
	(1, 10)	0.36	0.261	42:41	0.389

Panel B: Long-run Buy-and-Hold Abnormal Returns							
Return Group	Date	Mean BHAR	T1	Median BHAR	Percent Positive	Jensen's alpha	Sharpe ratio
Sample—	(1, 251)	-6.22%	-3.048***	-5.01%	37.3	-0.016%	-0.0114
Control	(1, 501)	-5.69%	-1.780*	-4.16%	39.7	-0.003%	-0.0041
83	(1, 751)	1.14%	0.253	-1.47%	49.4	0.006%	-0.0010

*** significance at the 1 percent level

** significance at the 5 percent level

* significance at the 10 percent level

Therefore, intra-industry price effects support the view that the announcement of Y2K readiness was an informative event, consistent with the evidence from Table 5. Moreover, the information conveyed by the announcement was industry wide, as opposed to firm specific.

¹ This CAR is slightly more negative than that reported in Table 3, Panel G. The sample is different, however, as we report abnormal returns in Table 9 using firms for which we were able to find appropriate control firms with available relevant data in both CRSP and Compustat (83 firms versus 96 in Table 3).

We next examine the long-run stock returns of a zero-investment portfolio that goes long in Y2K-ready announcing stocks and goes short in the control group. Table 9, Panel B shows buy-and-hold returns for up to three years after the announcement date. Following the recommendations of Barber and Lyon (1997), we use a skewness-corrected test to measure significance of average buy-and-hold returns.

Y2K-ready firms experience stock returns similar to those of control firms for the three years following the announcement date (that is, over the period 1999 to 2002).

Y2K-ready firms underperform control firms over 1999 to 2000, however, and outperform in the 2000 to 2002 period. Average compound abnormal returns for the zero-investment portfolio are -6.22 percent, -5.69 percent, and 1.14 percent in the one, two, and three years following the announcement date, respectively. First-year abnormal returns are significantly different from zero at the 5 percent level according to the skewness-corrected test. Although not reported in the table, buy-and-hold stock returns over the period 2000 to 2002 are 7.78 percent, which is significantly different from zero at the 10 percent level.

Overall, we conclude that the Y2K glitch was an important corporate event. Stock prices reacted negatively on average to announcement of Y2K readiness news. To the extent that the announcement implied no further preventive work by the announcing firm, investors might have reacted negatively if they still expected problems around the turn of year. Consistent with this, the announcement news conveyed negative intra-industry information. There is evidence, however, that investors were able to go past the mere announcement of Y2K readiness to assess the likelihood of Y2K-related problems. Short-term abnormal returns are larger the more firms invested in fixing possible problems, which indicates that investors saw the spending as efficient investment. Consistent with this, announcing firms have outperformed industry peers in terms of operating and stock return performance following the year 2000.

Conclusions

We investigate investors' expectations on the severity of the problems related to the Y2K glitch. Specifically, we examine stock price reactions around corporate announcements associated with the millennium bug.

We find that the announcement-day abnormal return is not significantly different from zero for the whole sample. Firms announcing the attainment of a Y2K-related contract, however, experience an abnormal return of 0.76 percent on the day of the announcement. The abnormal return is significantly different from zero at the 1 percent level. Similarly, providers of technical solutions experience a cumulative abnormal return of 3.57 percent over days (-1, 0), which is significant at the 5 percent level.

Companies that announce that they have entered into an alliance to fix Y2K-related problems, companies that announce Y2K-related products, or companies that announce the completion of a Y2K-remediation program experience abnormal returns that are not significantly different from zero at conventional levels.

In contrast, firms that announce that they are Y2K-ready experience a negative abnormal return of -0.36 percent on the announcement day. This abnormal return is significantly different from zero at the 5 percent level. For these companies, regression analysis reveals that abnormal returns are less negative the more a firm spent on fixing or preventing Y2K-related problems.

Overall, our results are consistent with the following story. The Y2K glitch was an important corporate event. Stock prices reacted negatively on average to announcement of Y2K readiness news. To the extent that the announcement implied no further preventive work by the announcing firm, investors might have reacted negatively if they still expected problems around the turn of year. Consistent with this, the announcement news conveyed negative intra-industry information. There is evidence that investors were able to go past the mere announcement of Y2K readiness to assess the likelihood of Y2K-related problems. Short-term abnormal returns are larger the more firms invested in fixing possible problems, which indicates that investors saw the spending as efficient investment. Consistent with this, announcing firms have outperformed industry peers both in operating and stock return performance following the year 2000. Thus, investors were able to distinguish between companies for which the issue was important and those for which it was not.

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