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ILLUSTRATING THE EFFECTS OF CROSS-SECTIONAL CORRELATION ON EVENT STUDY RESULTS: THE PRIVATE SECURITIES LITIGATION REFORM ACT OF 1995 REVISITED

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1 Introduction

We study the effects of method choice on the event study results related to a well-studied regulatory change that took place in the U.S. in 1995. Fast flow of information related to a Presidential veto and its subsequent overturn, paired with a well-defined set of most affected industries, make the Public Securities Litigation Reform Act of 1995 an interesting case study. Consistent with prior simulation studies, we find that event-induced variance and cross-sectional dependence have a marked effect on event study results in a case with severe event date clustering. We also report significant differences among different methods to account for cross-sectional correlation.

Event study methods have become the work horse of empirical finance research, and much of what we know, in particular of corporate finance, is based on event study evidence. While MacKinlay (1997) notes early uses of the method already in the 1930s, the increased availability of daily stock returns since the 1970s has been an important factor in making event study the method of choice in many finance inquiries.[1] According to Kothari & Warner (2007), 212 papers in the *Journal of Finance* make use of the event study methodology between 1975 and 2000. Further, Kolari & Pynnönen (2010, online appendix) list 75 event studies in leading finance journals that have accounted for event-inflated variance and cross-sectional correlation.

As the event study methodology is providing important evidence regarding financial phenomena, it is of utmost importance for finance researchers to have a solid understanding of the strengths and the pitfalls of the method. Along with event study's popularity, a much-needed literature has grown on the methodological

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[1] Fama, et al. (1969) is often viewed as the inaugural short-term event study in finance.

aspects of event studies. Thanks to those influential works, our knowledge has greatly increased over the years regarding the size and power properties of tests used in event studies, and the effects of issues such as event-induced variance and cross-sectional association between events[2]

Most of the previous studies on the statistical properties of the event study methodology make use of simulations, where the method's ability to capture a known economic effect chosen by the researcher is measured. In this paper, we have chosen a different path. We use an actual event with widespread effects on stock returns, as we re-visit a well-studied regulatory change that took place in the U.S. in 1995. In December 1995, the U.S. congress enacted on the Private Securities Litigation Reform Act (PSLRA), which would limit investors' ability to sue firms in securities fraud cases. However, President Clinton used his veto power on December 19, 1995 to overturn the legislation. The House of Representatives and the Senate subsequently voted to override the Presidential veto on December 20 and December 22, respectively. The fast flow of opposite types of information in this case provide an excellent opportunity for researchers to study the economic effects of the legislation. Indeed, a number of previous studies have considered the effects of the PSLRA on stock prices in industries that are most disposed to securities litigation, namely computers, electronics, pharmaceuticals/biotechnology, and retailing.[3]

As far as we can tell, the previous studies on the PSLRA fail to account for event-induced variance, which is of special concern in event studies with event date clustering, especially in those concerning regulatory changes, as they affect all sample firms simultaneously (Binder, 1985). The issue is an important one, as Harrington & Shrider (2007) show that problems with event-induced variance intensify in presence of cross-sectional correlation in the effects, and Kolari & Pynnönen (2010) provide evidence that even low levels of such correlation have a marked effect on inferences drawn from an event study. Obviously, in events with common event days, abundant potential sources for cross-sectional correlation exist. The use of a limited number of industry portfolios is also likely to increase the cross-sectional correlation within the sample. All three above-mentioned studies on the PSLRA use the so called portfolio method, which is suggested by Jaffe (1974) and Campbell, et al. (1997) as a solution to the cross-sectional dependence problems arising from extreme event date clustering in cases such as regulatory

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[2] See e.g. Brown & Warner (1980, 1985), Boehmer, et al. (1991), and Kolari & Pynnönen (2010, 2011).

[3] For prior studies on PSLRA, see Spiess & Tkac (1997), Johnson, et al. (2000), and Ali & Kallapur (2001). For analysis of litigation risk in the aforementioned industries, see Francis, et al. (1994).

changes[4]. However, as Kolari & Pynnönen (2010) note, the portfolio method suffers from low power. In this study, we use the Kolari & Pynnönen (2010) Adj-BMP test statistic to account for cross-sectional correlation in the effects of the PSLRA events, and contrast our findings with those obtained from the alternative methods.

2   The Private Securities Litigation Reform Act of 1995

The main purpose of the suggested PSLRA was to limit frivolous securities fraud law suits. A bipartisan view at the time was that the balance between deterring securities fraud and assuring that the private securities litigation process was not used abusively was severely tilted, and speculative securities class action suits were common (Phillips & Miller, 1996). Class action suits on securities fraud typically originate from alleged corporate misstatements that have resulted in losses to those investors who have bought the shares at artificially high prices. Prior to the PSLRA, the plaintiffs could file a law suit without identifying any specific corporate actions that had misled the investors. In order to curb frivolous filings, the PSLRA included provisions that required plaintiffs to specify the facts behind their claims. Furthermore, if the suit was later to be found frivolous, the plaintiffs would face penalties, such as paying the other parties' attorneys' fees (Ali & Kallapur, 2001). Also, the provisions of the PSLRA would limit liability of those defendants with a limited role in the alleged misconduct (King & Schwartz, 1997), whereas previously, large claims that were disproportionate in comparison to their part of the blame had been addressed to "deep-pocket defendants", such as accounting firms.

A common problem with event studies into law reforms is that regulatory changes take time, and their content tends to be intensely discussed, both publicly and privately, during the process. The PSLRA makes no exception to this, as Avery (1996) points to a "long and winding road" towards the proposal. Ali & Kallapur (2001) consider 18 legislative events during 1995, leading into the Presidential veto on December 20. Their portfolio of high litigation firms exhibits statistically significant returns on only six of those days. The relative lack of findings during the progress towards the PSLRA is likely to be due to the gradual learning of the

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[4] A simple way to account for event-induced variance in such setting would be to use heteroskedasticity-robust standard errors in hypothesis testing. However, Harrington & Shrider (2007) report that such consideration was not common at the time. Accordingly, none of the three previous empirical inquiries into the stock reactions upon the PSLRA mentions any corrections for heteroskedasticity.

regulation among market participants. However, the events around the Presidential veto in late December 1995 are likely to be less perfectly anticipated, and the significant event study evidence that is reported in prior studies on the reform supports that view.

While the sudden changes in the legislative process provide an interesting laboratory to study the economic effects of the PSLRA reform, some of the opposite effects unfortunately coincide, which challenges the clean identification in our study, and the previous studies alike. After the Congressional approval of the PSLRA, President Clinton received the bill on December 6, 1995. Clinton would have to sign the bill by December 19, 1995, or it would automatically become law. While the President was initially prepared to sign the bill, at the end, he vetoed it less than one hour before the deadline on December 19, 1995 (Johnson, et al., 2000). The House overrode his veto the next day, so that information regarding both the Presidential veto and the House override reached the market on the same trading day. However, rumors of eventual veto surfaced already on December 18, 1995, for which reason we follow prior studies into the PSLRA, and consider that date as our first event date[5]. All three previous studies on the reform find the December 20, 1995 abnormal returns to be positive and significant in the sample of high litigation industries, whereas December 18, 1995 abnormal returns are systematically negative.

3   Estimation and testing

When testing for event effects, the test statistic should account at least for (A) cross-sectional heteroskedasticity, (B) event-induced variance inflation, and (C) cross-sectional correlation. In the following treatment, we start by defining the models for abnormal returns and mean abnormal returns, and continue by stating three models for testing event effects in an increasing order of complication. Later, we also consider two additional models for reference.

We use continuously compounded abnormal returns in excess return format. They are defined as

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[5] Both Johnson, et al. (2000), and Spiess & Tkac (1997) mention that on Friday, December 15, President Clinton had a dinner with William Lerach, who was not only a well-known lawyer behind numerous securities fraud cases, and a vocal opponent of the PSLRA, but also a significant donor to the Democratic party. They speculate that the dinner affected Clinton's view on the PSLRA.

$$AR_{it}^e = R_{it}^e - \mathrm{E}\!\left(R_{it}^e\right), \quad i = 1,\dots,N, \quad t = 1,\dots,T_1,\dots,\tau,\dots,T_2, \tag{1}$$

where AR_{it}^e is the abnormal return in excess of the risk-free rate of return for event i, R_{it}^e is the observed excess return, and $\mathrm{E}(R_{it}^e)$ is the expected return. The estimation window ends at T_1, the event day is given by τ, and the whole sample period ends at T_2. We estimate the expected return with two alternative specifications, i.e., the Fama–French (1993) three-factor model (henceforth FF3) and the traditional one-factor market model:

$$E\!\left(R_{it}^e\right) = \alpha + \beta_{i,M} R_{mt}^e + \beta_{i,SMB} R_{SMB,t} + \beta_{i,HML} R_{HML,t}, \quad t = 1,\dots,T_1, \tag{2}$$

$$E\!\left(R_{it}^e\right) = \alpha + \beta_{i,M} R_{mt}^e, \quad t = 1,\dots,T_1, \tag{3}$$

where R_{mt}^e is the excess return on the market, R_{SMB} is the return on a portfolio with a long position in small company stocks and a short position in large-cap stocks, and R_{HML} is the return on a portfolio with a long position in high book-to-market stocks and a short position in low book-to-market stocks.

The effect of the event can be measured by the average abnormal return on the event day (day $\tau=0$), which is defined as

$$AAR_0 = \frac{1}{N} \sum_{i=1}^{N} AR_{i0}. \tag{4}$$

Another measure is given by the average standardized abnormal return, defined as

$$ASAR_0 = \frac{1}{N} \sum_{i=1}^{N} \frac{AR_{i0}}{s_i}, \tag{5}$$

where s_i is the time-series standard deviation over the estimation period. We prefer the specification in Equation (5), as standardizing alleviates problems with cross-sectional heteroskedasticity (A). The economic effect of the event should be assessed from the easy-to-understand average abnormal return, while the average standardized abnormal return is used for statistical significance testing.

The first statistic is the classic test calculating the standard error from the estimation period, in our paper labelled the *standardized residuals test* (*SRT*):

$$SRT = \frac{ASAR_{0,PC}}{\frac{1}{N} \sqrt{\sum_{i=1}^{N} \left(s_{i,Pat}^2\right)}}, \tag{6}$$

where $s_{i,Pat}^2$ is an estimate for the time-series standard deviation of the estimation period abnormal returns, incorporating a degrees of freedom correction as in Patell (1976) that stems from using an estimated standard deviation instead of the true standard deviation. Without the correction the denominator of Equation (6) simplifies to $1/\sqrt{N}$. In $ASAR_{0,PC}$, a prediction error correction has been made on the individual standardized abnormal returns. The correction arises from using regression parameters from the estimation period on predicting the normal return in the event period (see for example Campbell, et al. (1997), p. 159). Generally, the corrections are fairly small. Following the Lindeberg–Feller central limit theorem, *SRT* follows asymptotically the standard normal distribution.

While *SRT* accounts for cross-sectional heteroskedasticity (A), the statistic overstates the significance in presence of an event-induced increase in variance (B). To alleviate the problem, Boehmer, Musumeci and Poulsen (1991) combine the standardized residuals test and the cross-sectional approach to a statistic we label *BMP*:

$$BMP = \frac{ASAR_{0,PE}}{s_{ASAR_{0,PE}} / \sqrt{N}} \,, \tag{7}$$

where $ASAR_{0,PE}$ is corrected with the prediction error correction, and $s_{ASAR_{0,PE}}$ is an estimate of the cross-sectional standard deviation. *BMP* is *t*-distributed with *N*–1 degrees of freedom.

Neither *SRT* nor *BMP* accounts for cross-sectional correlation (C) among the abnormal returns, which is likely to plague evaluations concerning individual industries or studies that exhibit event-day clustering. Kolari & Pynnönen (2010) propose a correction to the BMP test that adjusts for cross-sectional correlation. We label the test KP, while Kolari & Pynnönen (2010) denote it as Adj–BMP:

$$KP = \frac{ASAR_{0,PE} \cdot \sqrt{N}}{s_{ASAR_{0,PE}} \cdot \left(1 + (N-1)\bar{r}\right)} = BMP \cdot \sqrt{\frac{1 - \bar{r}}{1 + (N-1)\bar{r}}} \,, \tag{8}$$

where $\bar{r}$ is the average correlation among the abnormal returns over the estimation period. If $\bar{r}$ is zero, KP simplifies back to BMP. The KP test is robust against all malign properties (A), (B) and (C) we mention above. *KP* is *t*-distributed with *N*–1 degrees of freedom.

For reference, we also use the crude dependence adjustment (CDA) set forth by Brown & Warner (1980, 1985):

$$CDA = \frac{ASAR_0}{\sqrt{\dfrac{1}{T_1-1}\sum_{t=1}^{T_1}\left(ASAR_t - \dfrac{1}{T_1}\sum_{t=1}^{T_1}ASAR_t\right)^2}}. \tag{9}$$

The standard error of *CDA* is simply the standard deviation of the time-series of average standardized abnormal returns over the estimation period. While this test accounts for cross-sectional correlation, it fails to account for event induced variance. *CDA* is *t*-distributed with T_1-1 degrees of freedom.

Finally, we also consider the portfolio method and use a regression model. The model is given by

$$R_{p,t}^e = \alpha + \beta R_{m,t}^e + \sum_{j=1}^{3}\gamma_j D_{j,t} + \varepsilon_{p,t}, \quad t = 1,\ldots,T_2, \tag{10}$$

where $R_{p,t}^e$ is the continuously compounded excess return on an equally-weighted portfolio over the whole sample period, $R_{m,t}^e$ the corresponding excess return on the market portfolio, and $D_{j,t}$ are indicator variables that take the value one on each of the event days and zero otherwise. The dates are defined in the next section. The parameters γ_j capture the event effects, which we then test both using OLS standard errors, and standard errors that are robust to heteroskedasticity and autocorrelation as in Andrews (1991), labelled *HACSE*. With event dates heavily clustered in calendar time, the *CDA* test, in which abnormal returns are estimated first, and the significance of the average abnormal return is then tested, is fairly similar to the portfolio method, in which the portfolio of returns is formed first, and the abnormal returns are then extracted. The main difference in our application is that the former uses standardized abnormal returns while the latter is based on non-standardized returns.

4   Data and results

In accordance with previous studies on the PSLRA, we use CRSP as our data source for daily stock returns. The factor returns for the Fama–French three-factor model are retrieved from Kenneth French's online data library. We limit our analysis to industries that are indicated as having high litigation risk in Francis, et al. (1994), namely computers (SIC codes 3570-3577 and 7370-7374), electronics (SIC codes 3600-3674), pharmaceuticals/biotechnology (SIC codes 2833-2836 and 8731-8734), and retailing (SIC codes 5200-5961). In the tests where firm-level abnormal returns are estimated, our estimation period starts on 3 January

1995 and ends 1 December 1995, and it thus comprises of 233 observations. There are slight variations between our paper and the prior studies on the PSLRA, regarding both estimation period and sample selection. In applying the portfolio method, the prior studies include the returns for the entire calendar year of 1995, in other words the time after the events is also included. We follow their choice in our portfolio tests. As the portfolio returns are tabulated on a day-by-day basis, Ali & Kallapur (2001) use a sample that varies in size throughout the estimation period due to missing returns. On the other hand, Johnson, et al. (2000) require their firms to "have a complete 1995 daily returns data". As we estimate abnormal returns for each individual firm separately, we require a minimum of 50 observations during the estimation period, with no missing values during the last ten days of the estimation window. Nevertheless, by using these filters, we retain a sample that is very similar in size to the prior studies. In comparison to Ali & Kallapur (2001), whose range of number of firms per industry is indicated in parentheses, our sample consists of 562 (492-579 in Ali & Kallapur, 2001) firms in computers, 472 (430-484) firms in electronics, 74 (74-79) firms in pharmaceuticals, and 434 (441-450) firms in retail.[6] Based on the flow of events around the Presidential veto and its overturn, as described in Section 2, we consider the following event dates: 18 December 1995, 20 December 1995 and 22 December 1995.

Table 1. Descriptive Statistics. The time period is 3 January 1995 to 29 December 1995. All returns are continuously compounded, in percentage format and in excess of the risk-free rate of return. The industry portfolios are equally-weighted while the market portfolio is value-weighted.

$T = 252$	Mean (annualized %)	Volatility (annualized %)	Minimum (in percent)	Maximum (in percent)	Skewness	Excess kurtosis
Computers	52.22	13.00	-3.95	1.80	-1.53	4.86
Electronics	47.97	12.59	-3.40	2.12	-1.30	3.40
Pharmaceuticals	32.65	10.19	-3.27	2.04	-0.75	3.20
Retail	13.04	7.62	-1.91	1.15	-0.59	0.98
Whole Sample	38.84	10.33	-3.03	1.50	-1.45	4.23
Market portfolio	19.75	7.42	-1.78	1.35	-0.42	1.44

Table 1 shows the descriptive statistics for equally-weighted portfolios for each of the four industries, and for the combined whole sample portfolio, as well as for the value-weighted market portfolio. The time period is 3 January 1995 to 29 De-

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[6] Ali & Kallapur (2001) note that Johnson et al. (2000) include SIC code 2830 in their pharmaceutical sample, which results in a significantly larger set of 191 firms. They further speculate that the difference in sample selection accounts for the fact that Johnson et al. (2000) findings regarding the pharmaceutical industry's reaction to the Senate override on 12/22/1995 deviate from those reported in Ali & Kallapur (2001) and Spiess & Tkac (1997). Johnson, et al. (2000) also separate Hardware and Software firms from the set that is very similar to our Computers sub-sample, and they do not consider the Retail industry in their analysis.

cember 1995, combining the estimation period, the event-dates and the post-event period, and thus totaling 252 observations. The returns are continuously compounded excess returns in percentage format. The annualized mean returns are fairly high, ranging from 13.0 percent to 52.2 percent and averaging at 38.8 percent, being almost twice the market return of 19.8 percent. The volatilities are fairly low, between 7.6 percent and 13.0 percent. Note, however, that the volatilities for individual companies are much larger on average (not reported). The values for skewness and excess kurtosis suggest that the daily returns are not normally distributed. In fact, Jarque-Bera (1987) tests for normality (not reported) reject the null hypothesis of normally distributed returns for all series.

We begin analyzing our data by having a first look at the time series of volatility in our sample. Figure 1 shows the cross-sectional standard deviation of the standardized abnormal returns based on the Fama-French three-factor model, and the five-day rolling standard deviation of the returns for our equally-weighted whole sample portfolio. Figure 1 clearly indicates that the time series of our sample exhibits heteroskedasticity. Part of that heteroskedasticity is likely due to the increased cross-sectional dependence during the event period, also indicated in Figure 1. Figure 1 thus serves as a further motivation for re-visiting the stock reactions to the PSLRA.
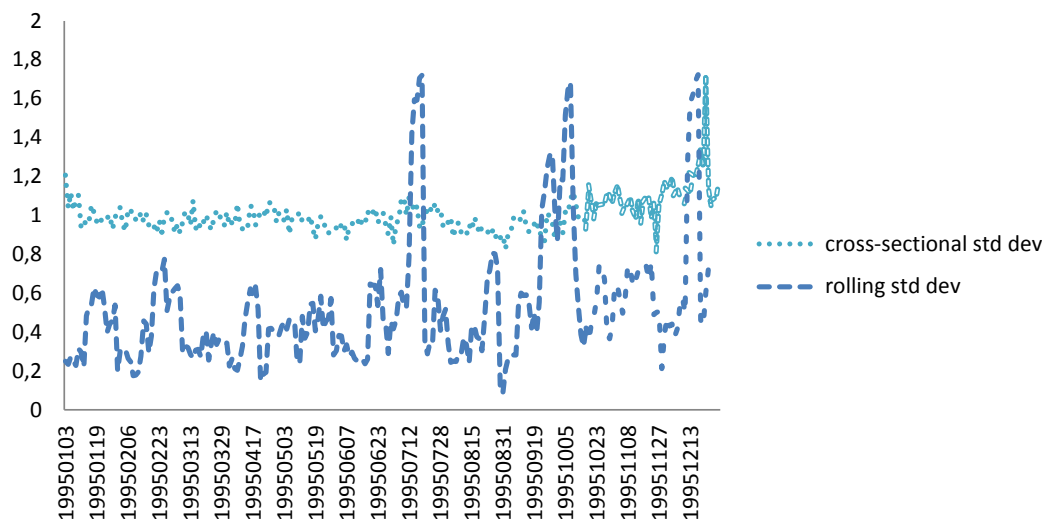
Figure 1.   Daily standard deviation of the cross section and the 5-day rolling time series

Table 2.   Tests for event effects on three event days for four industries. FF3 refers to the Fama–French (1993) three-factor model (2) and Market to the one-factor market model (3). SRT is the standardized residuals test (6), BMP the Boehmer et al. (1991) test (7), KP the Kolari & Pynnönen (2010) test (8), and CDA the crude dependence adjustment test (9). Pf. Method refers to the model indicated in Equation (10). All tests are t-tests. HACSE is the Andrews (1991) heteroskedasticity and autocorrelation consistent estimator for the standard error. * refers to statistical significance at 5 percent level, and ** refers to 1 percent.

Panel *A*. Computers	18 Dec 1995		20 Dec 1995		22 Dec 1995	
N = 562	FF3	Market	FF3	Market	FF3	Market
Abnormal return	-0.731	-1.908	-0.093	1.498	0.162	0.540
Std abnormal return	-0.122	-0.428	-0.056	0.338	0.007	0.103
SRT	-2.868**	-10.088**	-1.320	7.979**	0.170	2.430*
BMP	-2.230*	-7.913**	-1.031	6.279**	0.161	2.330*
KP	-1.424	-2.392*	-0.644	1.898	0.103	0.704
CDA	-1.789	-3.184**	-0.819	2.503*	0.108	0.765
Pf. Method OLS		-3.335**		2.873**		1.068
Pf. Method OLS HACSE		-7.132**		15.732**		14.080**

Panel *B*. Electronics	18 Dec 1995		20 Dec 1995		22 Dec 1995	
N = 472	FF3	Market	FF3	Market	FF3	Market
Abnormal return	0.198	-0.877	-0.584	0.906	-0.224	0.126
Std abnormal return	0.113	-0.176	-0.110	0.276	-0.032	0.058
SRT	2.452*	-3.802**	-2.384*	5.960**	-0.682	1.263
BMP	2.012*	-2.261*	-2.009*	5.130**	-0.606	1.144
KP	1.152	-1.084	-1.150	1.706	-0.347	0.380
CDA	1.312	-1.317	-1.284	2.050*	-0.384	0.436
Pf. Method OLS		-1.608		1.666		0.324
Pf. Method OLS HACSE		-3.735**		9.566**		4.988**

Panel *C*. Pharmaceuticals	18 Dec 1995		20 Dec 1995		22 Dec 1995	
N = 74	FF3	Market	FF3	Market	FF3	Market
Abnormal return	-1.894	-2.378	-0.075	0.764	0.168	0.350
Std abnormal return	-0.381	-0.522	-0.037	0.170	0.193	0.240
SRT	-3.265**	-4.466**	-0.313	1.451	1.653	2.054*
BMP	-2.768**	-3.658**	-0.228	0.989	1.555	1.945
KP	-2.135*	-2.674*	-0.177	0.723	1.200	1.422
CDA	-2.231*	-3.064**	-0.220	1.029	1.235	1.461
Pf. Method OLS		-4.066**		1.387		0.667
Pf. Method OLS HACSE		-14.856**		12.470**		9.821**

Panel *D*. Retail	18 Dec 1995		20 Dec 1995		22 Dec 1995	
N = 434	FF3	Market	FF3	Market	FF3	Market
Abnormal return	-0.456	-0.889	-0.088	0.859	0.117	0.310
Std abnormal return	-0.097	-0.225	-0.077	0.197	-0.054	0.003
SRT	-2.019*	-4.662**	-1.592	4.088**	-1.121	0.061
BMP	-1.665	-3.860**	-1.281	3.375**	-0.917	0.051
KP	-1.127	-1.954	-0.867	1.709	-0.621	0.026
CDA	-1.284	-2.326*	-1.014	2.109*	-0.747	0.032
Pf. Method OLS		-2.179**		2.427*		1.131
Pf. Method OLS HACSE		-7.672**		20.501**		16.136**

Panel *E*. Whole sample	18 Dec 1995		20 Dec 1995		22 Dec 1995	
N = 1542	FF3	Market	FF3	Market	FF3	Market
Abnormal return	-0.425	-1.328	-0.241	1.100	0.030	0.338
Std abnormal return	-0.055	-0.298	-0.077	0.271	-0.013	0.067
SRT	-2.159*	-11.641**	-3.022**	10.580**	-0.520	2.632**
BMP	-1.744	-9.494**	-2.420*	8.585**	-0.461	2.365*
KP	-0.926	-2.227*	-1.285	2.014*	-0.245	0.555
CDA	-1.135	-2.875**	-1.588	2.613**	-0.273	0.650
Pf. Method OLS		-3.023**		2.719**		0.961
Pf. Method OLS HACSE		-6.809**		15.355**		13.647**

Table 2 shows the results both for the individual industries and for the whole sample. Both non-standardized and standardized abnormal returns are reported. In the interest of space, we only report test statistics that refer to the standardized tests. Along with the *t*-statistics for the *SRT*, *BMP*, *KP*, and *CDA* tests, we also report the *t*-statistics obtained from the regressions of portfolio time series, using Equation (10).

Several interesting observations arise from Table 2. Looking at the whole sample, the results for 18 December are consistently negative and statistically significant across different methods for the market model. This is consistent with the prior studies mentioned above, with one exception. While Ali & Kallapur (2001) also find a negative reaction to the December 18 veto rumors when observing the "conventional *p*-value", they note the Jain (1986) finding that significance levels from the market model tend to be overstated when the market return is large on the event date. They mitigate the problem, by using a randomization method, which results in a *p*-value of only 0.16.

Our findings regarding December 20, 1995 indicate a positive and significant stock reaction when using the market model. Variability exists among industries and the Pharmaceuticals exhibit significant results only if the *Portfolio HACSE* method is considered. Finally, the December 22 results are weaker, albeit statistically significant with a number of samples and test statistics, such as the *SRT* and the *BMP* tests for the whole sample. Weaker findings are consistent with prior studies, as Johnson, et al. (2000) is the only one of the three studies to report statistically significant findings for the whole sample on that date.

Another interesting observation can be made regarding the differences between the market model and the FF3 results. In numerous instances, the two methods provide opposite findings. For example, the December 20 findings for the whole sample are positive and significant when the market model is used, but when the Fama-French factors are included in the estimation of abnormal returns, the results turn negative, and in the case of *SRT* and *BMP* statistics even statistically significant. It is also interesting to note the average correlation used in the *KP*

test. While the average correlation when using the FF3 model for the whole sample is 0.00165 (not reported), it is 0.01102 for the market model. This explains the larger corrections to the *t*-values when using the market model instead of the FF3 model.

Finally, we also observe large and seemingly systematic variation across test statistics. First, in comparison to the standardized residual test, the results tend to get statistically weaker when event-induced variance is accounted for, using the *BMP* method. However, the effect is generally moderate, which is somewhat surprising, given the large shift in the standard deviation around the event days, indicated in Figure 1. When the cross-sectional dependence is further accounted for by using the *KP* method, the *t*-values clearly decrease. This is intuitive, as the cross-sectional dependence may exist within an industry that is affected by the PSLRA, even after controlling for market-wide effects. The results for *CDA*, also accounting for cross-sectional correlation, are in line with those of *KP*. The correction is not as strong as the CDA test does not account for event-inflated variance. In a case such as ours, the critical question is whether individual firms should be considered as independent observations, or if part of the cross-sectional dependence is represented by the industry reaction to the news.

It is also worth noting that while the portfolio method with standard OLS gives results that are very comparable to the traditional abnormal return results, accounting for heteroskedasticity and autocorrelation with the *HACSE* correction appears to boost the statistical significance to an extreme.[7] Given the popularity of the portfolio method, as indicated by Kolari & Pynnönen (2010, online appendix), the inconsistency between the *BMP* adjustment to the traditional abnormal returns, and the *HACSE* correction to portfolio abnormal returns is interesting.

7   Conclusions

In this paper we study the effects of the Private Securities Litigation Reform Act (PSLRA), a regulatory change that took place in the U.S. in 1995, on four industries inclined to be affected by the reform. Despite some minor differences in sample selection procedures between our paper and the prior studies on the stock reactions to the PSLRA, our evidence is very similar to the previous results when

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[7] When we use the White (1980) standard errors only, instead of accounting also for autocorrelation with HACSE, we obtain *t*-statistics of similar magnitude (not reported). Note that Harrington & Shrider (2007) advocate the use of the regression method with White standard errors to account for event induced variance.

either the traditional event study methodology or the portfolio method with regular OLS t-statistics is used. We show, however, that the results are very sensitive to the choice of return generating model, and the choice between the market model and the FF3 model can even result in a change of the sign of the coefficient. We also show that correcting for event-inflated variance with the *BMP* method has a moderate effect on the significance of the results. However, when correcting for cross-sectional association between the abnormal returns as in Kolari & Pynnönen (2010), the significance of the results clearly decreases, showing that failing to account for cross-sectional effects may lead to spurious conclusions. The use of standard errors that are robust to heteroskedasticity and autocorrelation in the portfolio setting results in a very large upward shift in t-statistics. This is a puzzling result, and calls for further research.

Finally, we would like to congratulate Seppo Pynnönen on his 60th birthday. All the best!

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