ISSN 1045-6333

INSIDER TRADING AND MERGERS: THE EFFECT OF ILLEGAL TRADING UPON TARGET FIRMS' PRE-ANNOUNCEMENT PRICE ACTIVITY

Stephen O'Brien* and John F. Stewart

Discussion Paper No. 68

3/90

Program in Law and Economics
Harvard Law School
Cambridge, MA 02138

The Program in Law and Economics is supported by a grant from the John M. Olin Foundation.

*John M. Olin Fellow in Law and Economics and student at Harvard Law School.

ABSTRACT

This study presents evidence about the effects of illegal insider trading on the pre-announcement stock prices of merger targets. Unlike other economic studies which test hypotheses about insider trading by focusing on the actions of corporate directors or significant shareholders, this work incorporates legal data obtained from recent insider trading litigation. This allows one to concentrate on the true area of interest--illegal trading activity.

Numerous researchers have observed that a merger targets earn huge premiums, much of which is recognized by the market even prior to public announcement of the transactions. This study once again confirms that insiders indeed earn tremendous excess returns, but also finds that the stock price runups of the targets occur significantly before the illegal traders acquired their information and acted upon it. Given this result, an effort is then made to estimate how much of the pre-announcement activity can be attributed to illegal traders. These efforts lead to the conclusion that illegal traders are responsible for at least 40 percent of the pre-announcement stock price activity.

INSIDER TRADING AND MERGERS: THE EFFECT OF ILLEGAL TRADING UPON TARGET FIRMS' PRE-ANNOUNCEMENT PRICE ACTIVITY

Stephen O'Brien and John F. Stewart

January 26, 1990

We would like to thank Jennifer Conrad, Helen Tauchen, Bob Lee, and David McFarland for helpful comments on the formitive stages of this research. A special thanks goes to Jennifer Conrad for her assistance in the computer programming necessary to perform this work. Charles Mahla, Jonathan Cohen, Scott Siff, Terrance Yang, John Kenny, Andrew Feldstein, Reinier Kraakman, and Arthur Keown provided helpful comments on various versions of this work. We would also like to thank the John M. Olin Foundation and the Harvard Law School Program in Law and Economics for financial support.

INSIDER TRADING AND MERGERS: THE EFFECT OF ILLEGAL TRADING UPON TARGET FIRMS' PRE-ANNOUNCEMENT PRICE ACTIVITY

Stephen O'Brien and John F. Stewart

Section 1. Introduction

Insider trading, the act of trading a security while in possession of nonpublic information which will affect the security's price, has received growing attention in recent years. This attention has been heightened by the merger wave of the 1980s which has created situations where entrepreneurs, investment bankers and corporate lawyers possess nonpublic information which can greatly affect the stock prices of merging firms. The public perceives that these "insiders" are making very profitable trades prior to the merger announcements and, therefore, that the stock market is an extremely unlevel playing field. The SEC and Congress have responded with stepped-up enforcement and stiffer laws. The SEC, however, maintains that much of the stock price activity prior to a merger announcement results from legitimate speculation based primarily on information provided by the financial press.

Ex-chairman Shad stated:

> [i]t is very difficult to quantify the magnitude of insider trading. What many think is insider trading is more often than not legal speculation on rumors and gossip. Based on the highest published conjectures, all fraudulent securities activities, including insider trading, amount to a fraction of 1 percent of the multibillions of dollars of corporate and Government securities that trade daily in America.[1]

In early 1987, the Chief Economists at the SEC published a study

supporting Shad's general thesis.[2] The economists conclude that a great deal of the pre-announcement price activity derives from legitimate sources and, specifically, they attribute about one-third of the pre-announcement activity to speculation in the press.

It is the purpose of this research to focus on these diverging attitudes between the public and the SEC, and to quantify the significance of illegal trading activity. This is done by combining the intuition and analysis of the legal and economic literature on insider trading with the event-study methodology from finance theory.

The search for illegal insider trading will focus primarily on the target firms in mergers, acquisitions, and similar business combinations for several reasons. First, the popular press and the SEC certainly suggest that insider trading is likely to occur around such events.[3] Second, an examination of the recent insider trading cases shows that over 80 percent of these cases concerned illegal trades based on information about upcoming merger announcements.[4] Third, by focusing on similar types of transactions, the composition of the portfolios to be generated should be more homogenous, thus making it easier to control for outside influences which might bias the results. The announcements of other extraordinary corporate events, and the potential insider trading around them, are thus left for another day.

The following is divided into four sections: section 2 defines insider trading for the purposes of this paper; section 3 establishes the research design used; section 4 presents the results on the significance of insider trading; and finally, section 5 concludes the paper.

Section 2. Definition of Insider Trading

A significant difference exists between the definitions of insider trading used by lawyers and by economists, so it will be necessary to define "illegal insider trading." This definition will also be important to distinguish "insider trading" as used in past economic studies and "illegal insider trading" as used in this paper. The pertinent law for dealing with insider trading is the Securities and Exchange Act of 1934, specifically §§ 9 and 10, 13 and 14, and 16.[5] Rules 10b-5 and 14e-3 are of the most significance, outlawing schemes involving interstate commerce, the mails, or national securities exchanges which intend to defraud or intentionally mislead individuals in connection with buying or selling securities.

Many economists, however, do not look at the law first in defining insider trading, but instead define it as any type of asymmetric information, any situation where one individual possesses superior information relative to another. This definition is generally operationalized by observing the trades made by corporate executives and significant shareholders[6]. This is done due to data availability--the SEC publishes monthly all trading activity of these investors in its Official Summary of Security Transactions and Holdings.[7] The Official Summary is the obvious source of data for economic studies focusing on market efficiency issues since corporate directors, executives and significant shareholders possess more information and better quality information about their firms than the small investor. For discussing the policy issues of illegal insider trading, however, the Official Summary is not the best source of data. Illegal insider trading deals

with those individuals in violation of §§ 10, 14 and 16 of the SEA 1934. Carlton and Fischel explain that using the Official Summary definition actually overstates the amount of insider trading because the illegal activities,

> . . .trades motivated by knowledge of "bombshell" events which are the substance of lawsuits[,] are the aberration, not the rule. Far more common are trades that allow insiders to earn rates of return that are on average slightly in excess of the market as a whole on a risk-adjusted basis. These trades, though based on "inside" information in an economic sense (i.e. knowledge of information not fully reflected in stock prices), are not subject to legal attack because the materiality requirement is not satisfied.[8]

Common sense suggests a further reason to expect that the Official Summary overstates illegal trading and contains primarily legal trades: these are reported trades. Corporate insiders may very well leak the information so that others can profit (and perhaps compensate them), but they are highly unlikely to commit a crime and then report the activity.

For the purposes of this paper, therefore, illegal insider trading will be defined as by ex-chairman Shad:

> 'Insider trading' refers generally to the act of purchasing or selling securities in breach of a fiduciary duty or other relationship of trust and confidence, while in possession of material nonpublic information about an issue of the trading market for an issuer's securities.[9]

This definition applies not only to corporate directors and significant shareholders, but also to fiduciaries of the corporation and those who misappropriate information from the firm. For ease in identifying the

"bombshell" events which are likely to result in the misappropriation of information, this study will limit its focus to fraudulent activities around mergers, tender offers and similar business transactions.

Although this definition is certainly not as precise for data-collection purposes as the Official Summary definition, it more precisely focuses on the real issue of interest--illegal insider trading. Further, this definition incorporates all three aspects of insider trading (§ 16 violations, § 10 fraud, and tender offer manipulations in § 14) which is an advantage over the Official Summary definition which limits its focus to only § 16 issues.[10]

Section 3. Data and Methodology

To uncover evidence about illegal insider trading, this paper examines the pre-announcement stock-price activity of target firms involved in mergers and acquisitions. Two portfolios are compiled and each contains merger and acquisition targets from 1980 through 1987. Statistical tests then compare the price activity of these portfolios and provide the results for this study.

3.1. Data

The two portfolios compiled are labeled the "dirty" and the "clean" portfolios. The "dirty" portfolio contains securities of merger and acquisition targets known to have been traded upon illegally, and the "clean" sample contains stocks of target firms not known to have been involved in any insider trading litigation.

All firms included in the samples were (or are) traded on either the New York Stock Exchange or the American Stock Exchange, and the corporate transactions were announced between January 1980 and December 1987. Target firms are chosen because previous merger studies suggest that most of the value gains from merger announcements manifest themselves in the returns of the target firms rather than acquiring firms. While the stock prices of the target firms jump dramatically with the public announcements,[11] the acquiring firms' returns stay roughly constant with the market and may be slightly negative.[12] Realizing this to be the case, intelligent insiders will only be interested in the target firms, so these are the relevant firms to study.

Each firm listed in the portfolios is researched by reading through the Wall Street Journal Index for merger-related news stories, and from this research, an announcement date for each transaction is acquired. The announcement date for each transaction is, in general, the last trading date prior to a Wall Street Journal story announcing the transaction. In some cases, this date is adjusted backwards if news stories indicate that negotiations are taking place or that a transaction is imminent and one indeed does follow within the next two months. This prior date is justified since the public, or at least a significant number of outsiders, including the Wall Street Journal and its readers, foresee a transaction. This adjustment allows the study to ignore a good deal of pre-announcement stock price activity caused by information which is widely available and, therefore, no longer material nonpublic information.

3.1.1. "Dirty" Portfolio

The "dirty" portfolio is created by researching the legal records of the January 1986-June 1989 insider trading cases. Any case settled by injunctive relief, consent decree, disgorgement of profit, civil penalty, or criminal sanctions was included in the research. 58 primary cases were tracked and the major defendants are listed in Appendix A. Data on the securities involved in these cases comes from the complaints, other court documents and news stories found in the Commerce Clearing House Federal Securities Law Reports, the Bureau of National Affairs Securities Regulation and Law Report, the SEC News Digest, Lexis computerized legal research service, and the Wall Street Journal.

For 62 securities, complete information is available on when the transactions were announced publicly or (if different) when the WSJ reported the transactions as imminent (adjusted announcement dates), and when the defendants bought or sold the securities. This information is displayed in Table 3.1. Daily stock return data[13] was not available for all 62 firms, primarily because not all were traded on either the NYSE or the AMEX, so not all of these firms are included in the actual "dirty" portfolio. Many other firms were listed in the legal documents, but information about the trading dates is not available. While these firms are, therefore, not included in Table 3.1, they are included in the portfolios if returns data are available.

Returns data are available for a total of 79 firms, which comprise the "dirty" portfolio. These firms are listed in Table 3.2. 68 firms come from the NYSE and 11 from the AMEX. The vast majority of these 79 merger announcements led to successful transactions--only 11 of the

TABLE 3.1
ILLEGALLY-TRADED SECURITIES

Security	Announcement Date	Public Announcement Date	Dates Traded
Alexander & Alexander Services, Inc.	830713	830713	830705-06
Allied Maintenance	820617	820617	820510
American Natural Resources	850227	850301	850214,15-24
Associated Engineering PLC	861103	861103	861103
Bendix	820907	820907	800902
Carter Hawley Hale Stores	840402	840402	840322,29
Charter Co. of Jacksonville	840415	840415	840411
CIGNA	860130	860130	860130
Cone Mills Corp.*	831106	831129	831115
Continental Group	840605	840605	840523
Criton Corp.	820823	820823	820817
Crowley Milner & Co.	850613	850613	850611
Crown Zellerbach	850401	850428	850328
Dart Industries	800605	800605	800605
Day Mines, Inc.	810322	810323	810318
Diasonics	830921	830921	830907-09
Energy Reserves Group Inc.	841105	841105	841031-1102
Esmark, Inc.**	840229	840523	840518
Esquire, Inc.	831205	831205	831028, 1202
Financial Corp. of America	850308	850308	850227-0307
First National Supermarkets	850606	850606	850318-19
Four Phase Systems, Inc.	811210	811210	811202
Gartner Group, Inc.	880613	880613	880506, 27
Gulfstream Aerospace	850602	850602	850530
HMW Industries, Inc.	830816	830816	830815
Hanna Mining Co.	820405	820405	820331
Hobart Corp.***	801215	810218	810129
Houston Natural Gas	850502	850502	850430
Huyck Corp.	800728	800728	800728
Instrumentation Laboratory	830131	830131	830104
Intercole, Inc.	841210	841210	841206, 07
Itek Corp.	830116	830116	821112, 15
Jewel Companies, Inc.	840501	840601	840322, 0402
Carl Karcher Enterprises, Inc.	841023	841023	841015, 17, 19, 22
Lorimar	851007	851007	850930,1002
Lucky Stores, Inc.	880322	880322	880316-18
Ludlow Corp.****	810428	810818	810812
Marathon Oil	811031	811031	811029, 30
Marshall Field & Co.	820616	820316	820310
Maryland Cup Corp.*****	830530	830628	830610-22
Nabisco Brands, Inc.	850529	850529	850506, 21

National Gypsum	860408	860408	860408,09
Northwestern Financial Corp.	850304	850304	850227
Pacific Lumber	850930	851022	851001
Peavey Co.	820418	820418	820414
RCA Corp.	851211	851211	851205, 06-09
SFN	840823	840823	840817,
Signode	820301	820301	820209-26
Simmonds Precision Products, Inc.	830628	830628	830616, 21
Specialized Systems, Inc.	850227	850227	850221, 27
Sta Rite Industries, Inc.	820523	820523	820519
St. Joe Minerals Corp.	810311	810311	810310
Sunbeam Corp.	810921	810921	810911
Supron Energy Corp.******	820113	820211	820208
Texasgulf, Inc.	810626	810626	810616
Textron, Inc.	841024	841024	841001
Thiokol Corp.	820719	820719	820713
Tymshare*******	831117	840223	840223
Union Carbide Corp.	851208	851208	851203
Viacom, Inc.	860916	860916	860910
Waldbaum, Inc.*	861127	861127	864424, 26
Wallace Murray Corp.	810203	810218	810129

*. Western Pacific Industries announced on 11/06/83 its intentions to seek control but had not formulated any specific plans; trading was halted on 11/29/83.

**. Kohlberg, Kravis, Roberts & Co. (first suitor) made an offer on 2/29/84; defendant traded prior to a subsequent Beatrice tender offer announcement on 5/22/84.

***. Canadian Pacific Enterprises (first suitor) began a tender offer on 12/15/80; Hobart announced decision to merge with Day & Kraft (white knight) on 2/18/81. Insider trading was based on the latter announcement.

****. Tyco Lab began purchasing significant blocks of Ludlow on 4/26/81 and announced takeover intentions on 7/1/81; insider trading was based on a later, competing bid by Bairnco Corp.

*****. Announced on 5/30/83 that it was holding merger talks with an unidentified company; Fort Howard agreed to buy on 6/28/83. Insider trading occurred on the latter announcement.

******. Announced on 1/13/82 that it had been holding acquisition talks with Allied Corp.; Allied and Continental Group announced a joint acquisition on 2/10/82.

*******. Announced on 11/17/83 that it was involved in "preliminary discussions" with a company about its acquisition; trading was halted on 2/23/84 pending an announcement on 2/27/84.

TABLE 3.2
DIRTY PORTFOLIO

Target firms with announcement dates between 1980-87 and involved in cases prosecuted between 1986-89.

CUSIP	TICKER SYMBOL	FIRM NAME	STOCK EXCHANGE	ANNOUNCEMENT DATE
00823010	AFH	AFFILIATED HOSPITAL PRODUCTS, INC.	AMEX	850114
01447610	AAL	ALEXANDER & ALEXANDER SERVICES	NYSE	870313
01926710	ALM	ALLIED MAINTENANCE CORP.	NYSE	820617
02860910	ANR	AMERICAN NATIONAL RESOURCES CO.	NYSE	850227
05439310	AVD	AVONDALE MILLS	AMEX	860205
08168910	BX	BENDIX CORP.	NYSE	820907
14348310	CMK	CARNATION CO.	NYSE	840904
14622710	CHH	CARTER HAWLEY HALE STORES, INC.	NYSE	840402
15130310	CNC	CENCO, INC.	NYSE	810903
17303610	CS	CITIES SERVICES CO.	NYSE	820527
20681310	COE	CONE MILLS CORP.	NYSE	831106
21145210	CCC	CONTINENTAL GROUP, INC.	NYSE	840605
22674510	CN	CRITON CORP.	NYSE	820823
22809310	COM	CROWLEY MILNER & CO.	AMEX	850613
22866910	ZB	CROWN ZELLERBACH CORP.	NYSE	850401
23576610	DAM	DAMSON OIL CORP.	AMEX	831006
23742410	D	DART INDUSTRIES, INC.	NYSE	800605
23954110	DMI	DAY MINES, INC.	AMEX	810322
25274110	DIA	DIAMOND SHAMROCK CORP.	NYSE	850106
28565910	EDS	ELECTRONIC DATA SYSTEMS CORP.	NYST	840516
29647010	ESM	ESMARK, INC.	NYSE	840229
29665910	ESQ	ESQUIRE, INC.	NYSE	831205
31944110	FCF	FIRST CHARTER FINANCIAL CORP.	NYSE	830111
35089720	FPS	FOUR PHASE SYSTEMS, INC.	NYSE	811210
36602810	GBM	GARFINKEL BROOKS BROTHERS MILLER	NYSE	810814
36882010	GAO	GENERAL AMERICAN OIL CO. OF TEXAS	NYSE	821219
36985610	GF	GENERAL FOODS CORP.	NYSE	850924
37428010	GET	GETTY OIL CO.	NYSE	831217
40273310	GA	GULFSTREAM AEROSPACE CORP.	NYSE	850602
40424510	HMW	H M W INDUSTRIES, INC.	NYSE	830816
41055210	HNM	HANNA M A CO.	NYSE	820405
41454510	HG	HARRIS GRAPHICS CORP.	NYSE	860417
42749210	HER	HERMAN'S SPORTING GOODS, INC.	NYSE	860320
43372810	HOB	HOBART CORP.	NYSE	801215
44227210	HNG	HOUSTON NATURAL GAS CORP.	NYSE	850502
44849910	EFH	E F HUTTON GROUP, INC.	NYSE	871123
44851010	HYK	HUYCK CORP.	NYSE	800728
45852910	IC	INTERCOLE, INC.	AMEX	841210
45967910	HYD	INTERNATIONAL HYDRON CORP.	AMEX	840913
46563210	ITK	ITEK CORP.	NYSE	830116
47719610	JWL	JEWEL COMPANIES, INC.	NYSE	840501

48262010	KNE	KN ENERGY, INC.	NYSE	860211
50185810	LFE	L F E CORP.	NYSE	841216
52626410	LNX	LENOX, INC.	NYSE	830608
54415510	LRM	LORIMAR	AMEX	851007
54664210	LCO	LOUISVILLE CEMENT CO.	AMEX	840926
54777910	LST	LOWENSTEIN M. CORP.	NYSE	851008
54966210	LUD	LUDLOW CORP.	NYSE	810426
56584510	MRO	MARATHON OIL CO.	NYSE	811030
57234210	MF	MARSHALL FIELD & CO. DEL	NYSE	820316
57405510	MDC	MARYLAND CUP CORP.	NYSE	830530
62952510	NB	NABISCO BRANDS, INC.	NYSE	850529
63631610	NG	NATIONAL GYPSUM CO.	NYSE	860408
66744610	NWP	NORTHWEST ENERGY CO.	NYSE	830805
69452910	PL	PACIFIC LUMBER CO.	NYSE	850930
70430110	PAY	PAYLESS DRUG STORES NORTHWEST	NYSE	850114
70504110	PV	PEAVEY CO.	NYSE	820418
71850710	P	PHILLIPS PETROLEUM CO.	NYSE	841107
74928510	RCA	RCA CORP.	NYSE	851211
76312110	RCS	RICHARDSON CO.	NYSE	811030
78415010	SFN	SFN COMPANIES, INC.	NYSE	840823
78659910	SGA	SAGA CORP.	NYSE	850507
79345310	SRT	ST. REGIS CORP.	NYSE	840715
82669010	SGS	SIGNODE CORP.	NYSE	820301
82867510	SP	SIMMONDS PRECISION PRODUCTS, INC.	NYSE	830628
85230810	SRE	STA RITE INDUSTRIES, INC.	NYSE	820523
86213110	SCI	STORER COMMUNICATIONS, INC.	NYSE	850425
86706810	SMB	SUNBEAM CORP. DEL	NYSE	810921
86863810	SUE	SUPRON ENERGY CORP.	AMEX	820113
88243510	TXG	TEXAS GAS RESOURCES CORP.	NYSE	830605
88288710	TG	TEXASGULF, INC.	NYSE	810628
88320310	TXT	TEXTRON, INC.	NYSE	841024
88410210	THI	THIOKOL CORP.	NYSE	820719
89401510	TNW	TRANSWAY INTERNATIONAL	NYSE	850821
90238410	TYM	TYMSHARE, INC.	NYSE	831117
90558110	UK	UNION CARBIDE CORP.	NYSE	851208
91528910	UCL	UNOCAL CORP.	NYSE	850328
91750810	UTP	UTAH POWER & LIGHT CO.	NYSE	870728
92552410	VIA	VIACOM, INC.	AMEX	860511
93235510	WMC	WALLACE MURRAY CORP.	NYSE	810203

firms are currently traded on the exchanges.

3.1.2. "Clean" Portfolio

To compare the results of the "dirty" portfolio, a control sample is gathered. This "clean" portfolio is comprised of securities not mentioned in the cases and not mentioned as being "suspected transactions" in the WSJ reporting of the cases. From the CRSP tapes, a list is gathered which contained all firms with final trading dates between 1980 and 1987. Thus all the firms in the "clean" portfolio were targets in successful mergers or acquisitions. 125 firms are randomly drawn from this list. All "dirty" and "suspected" firms are removed from the list of 125, and the first 79 firms left make up the "clean" portfolio, which is listed in Table 3.3. 52 of the 79 firms come from the NYSE and 28 from the AMEX.

3.2. Research Design

Armed with this data, the research proceeds with relatively simple event studies and statistical tests performed on the various portfolios. (See Appendix B for the mathematical presentation of the event study and statistical tests.) Each firm's excess returns are first calculated using an OLS market model[14] for a 200-day estimation period which ends roughly one month prior to the announcement date. These excess returns are averaged over all the firms in the portfolio to yield a portfolio excess return. The returns are also standardized to be tested for significance. Finally, cumulative abnormal returns are calculated by summing the daily portfolio excess returns. If the market accurately explains the activity within the portfolio, the excess returns should

TABLE 3.3
CLEAN PORTFOLIO

Target firms with announcement dates between 1980-87 and not involved in any prosecutions.

CUSIP	TICKER SYMBOL	FIRM NAME	STOCK EXCHANGE	ANNOUNCEMENT DATE
00723910	AOI	ADOBE OIL & GAS CORP.	AMEX	850214
01020210	AXO	AKZONA OIL & GAS CORP.	NYSE	820907
01388010	ALC	ALCOLAC, INC.	AMEX	810119
02042510	ALY	ALMY STORES, INC.	AMEX	840415
03014110	ATM	AMERICAN TECHNICAL INDUSTRIES, INC.	AMEX	800918
07581510	BEC	BECKMAN INSTRUMENTS, INC.	NYSE	811124
10901710	BRI	BRIGADIER INDUSTRIES CORP.	AMEX	821018
12540710	CBF	C H B FOODS, INC.	AMEX	850117
12633010	CSE	C S E CORP.	AMEX	801222
12879310	CA	CALDOR, INC.	AMEX	810126
14450110	CGR	CARRIERS & GENERAL CORP.	NYSE	810510
15733910	CWK	CHADWICK MILLER, INC.	AMEX	840528
16866410	CID	CHIEFTAIN DEVELOPMENT LTD	AMEX	820617
18148610	CKO	CLARK OIL AND REFINING CORP.	NYSE	810715
19325210	CBC	COLDWELL BANKER & CO.	NYSE	811005
19322810	CLE	COLE NATIONAL CORP.	NYSE	840604
22838110	KRO	CROWN INDUSTRIES, INC. FLA	AMEX	850219
25416510	DIL	DILLON COMPANIES, INC.	NYSE	830125
25612910	DOC	DR PEPPER CO.	NYSE	831116
29173710	EI	EMPIRE, INC.	NYSE	821021
29454210	EQ	EQUITABLE LIFE MTG RLTY INVS SBI	NYSE	820701
31438710	FEL	FELMONT OIL CORP.	AMEX	840618
31749510	FFI	FINANCIAL FEDERATION, INC.	NYSE	830313
34056710	FCC	FLORIDA CAPITAL CORP.	AMEX	831229
35907610	FA	FRONTIER HOLDINGS, INC.	AMEX	850403
37085610	GSI	GENERAL STEEL INDUSTRIES, INC.	NYSE	811102
41619410	HHN	HARTE HANKS COMMUNICATIONS, INC.	NYSE	840327
44974410	INA	I N A CORP.	NYSE	811109
45666810	IG	INFORMATICS GENERAL CORP.	NYSE	850415
46057810	INP	INTERPACE CORP.	NYSE	830815
47024510	JMS	FRED S. JAMES & CO., INC.	NYSE	821101
48203110	JUN	JUNIPER PETROLEUM CORP.	AMEX	821031
48309810	KSC	KAISER STEEL CORP.	NYSE	830509
48409410	KML	KANE MILLER CORP.	NYSE	831031
50075510	KRA	KRAFT, INC.	NYSE	800605
50186110	LBC	LITCO BANCORPORATION NY, INC.	NYSE	810405
53225310	LOL	LIGHTHOLIER, INC.	AMEX	810904
55037410	LDY	LUNDY ELECTRONICS & SYSTEMS, INC.	AMEX	860212
55339310	MPO	M P O VIDEOTRONICS, INC.	AMEX	801221
56128010	MHI	MALONE & HYDE, INC.	NYSE	840610
57389010	MKY	MARY KAY COSMETICS, INC.	NYSE	850530

57541810	MMS	MASS MERCHANDISERS, INC.	NYSE	850507
57990410	MCP	McCORMACK OIL & GAS PARTNERSHIP	AMEX	850317
58243010	MOX	McMORAN OIL & GAS CO.	NYSE	811215
58339310	MNS	MEANS SERVICES, INC.	AMEX	820124
58600510	MRX	MEMOREX CORP.	NYSE	810728
60766210	MOM	MODERN MERCHANDISING, INC.	NYSE	820609
62428410	MOU	MOUNTAIN STATES TEL. & TELEG. CO.	NYSE	800820
63512810	NAC	NATIONAL CAN CORP.	NYSE	840112
63690510	NMS	NATIONAL MINE SERVICES CO.	NYSE	821214
63758910	NSR	NATIONAL SECS. & RESH. CORP.	AMEX	830920
65347110	NFS	NIAGARA FRONTIER SERVICES, INC.	AMEX	830504
65715210	NAR	NORTH AMERICAN REALTY, INC.	AMEX	830427
66870710	NSI	NORTON SIMON, INC.	NYSE	830605
69432510	PGT	PACIFIC GAS TRANSMISSION CO.	AMEX	850909
69776010	PAB	PAN AMERICAN BANK, INC.	NYSE	850724
69931310	PAR	PARAMOUNT PACKAGING CORP.	AMEX	850121
70456210	PBD	PEABODY INTERNATIONAL CORP.	NYSE	850620
74631610	PFC	PURITAN FASHIONS CORP.	NYSE	831114
74836910	IQ	QUESTOR CORP.	NYSE	820322
76035420	REP	REPUBLIC CORP.	NYSE	840729
76328210	RVI	RICHARDSON VICKS, INC.	NYSE	850909
78024010	RCC	ROYAL CROWN COMPANIES, INC.	NYSE	840110
78387810	SCV	S C A SERVICES, INC.	NYSE	840610
78401510	SCM	S C M CORP.	NYSE	850821
80460010	SVS	SAV A STOP, INC.	NYSE	820106
80461710	SVN	SAV ON DRUGS, INC.	NYSE	800806
81064010	SCO	SCOVILL, INC.	NYSE	841219
81209810	SG	SEALECTRO CORP.	AMEX	810727
81524610	SED	SEDCO, INC.	NYSE	840913
84357110	SX	SOUTHERN PACIFIC CO.	NYSE	830926
85914510	SBI	STERCHI BROTHERS STORES, INC.	NYSE	860112
86511210	SUL	SULLAIR CORP.	NYSE	840612
87852110	TK	TECHNICOLOR, INC.	NYSE	821031
88162110	TT	TETRA TECH, INC.	AMEX	820216
89054110	TPZ	TOPAZ, INC.	AMEX	821005
89334110	TU	TRANS UN CORP.	NYSE	800922
89558010	TSI	TRI SOUTH INVESTMENTS, INC.	NYSE	841018
90288610	UP	UMET PROPERTIES CORP.	NYSE	840430
97816510	WOM	WOMETCO ENTERPRISES, INC.	NYSE	830818

average to, and the cumulative pattern of returns should hover around, zero during the estimation period.

Using the OLS parameters from the estimation period, forecast errors are calculated in the event window which runs from 30 days prior to the announcement date to 5 days afterwards. As in the estimation period, the event window excess returns are averaged over the portfolio, accumulated, and tested for significance. Runup indices are also calculated over the event window. Assuming that the market is semi-strong efficient,[15] by day +1 all nonpublic information should be conveyed to the market and the stock price should reflect the true value of the firm. The runup for each day, then, is simply the percentage of the day +1 CAR that each day's CAR represents, and the index will show how quickly the portfolio returns adjust to the post-announcement market value. Based on the previous merger research,[16] one certainly expects the excess returns, CARs and runups in the event window to be highly significant, especially in the days immediately prior to the announcement.

The event study and statistical tests are performed on the "dirty" portfolio to uncover the characteristics of illegal insider trading. Performing the event study on both the "clean" and "dirty" portfolios allows for a comparison between the samples and an attempt to uncover the significance of illegal trading.

Section 4. The Significance of Illegal Insider Trading

4.1. The Profitability of Illegal Insider Trading

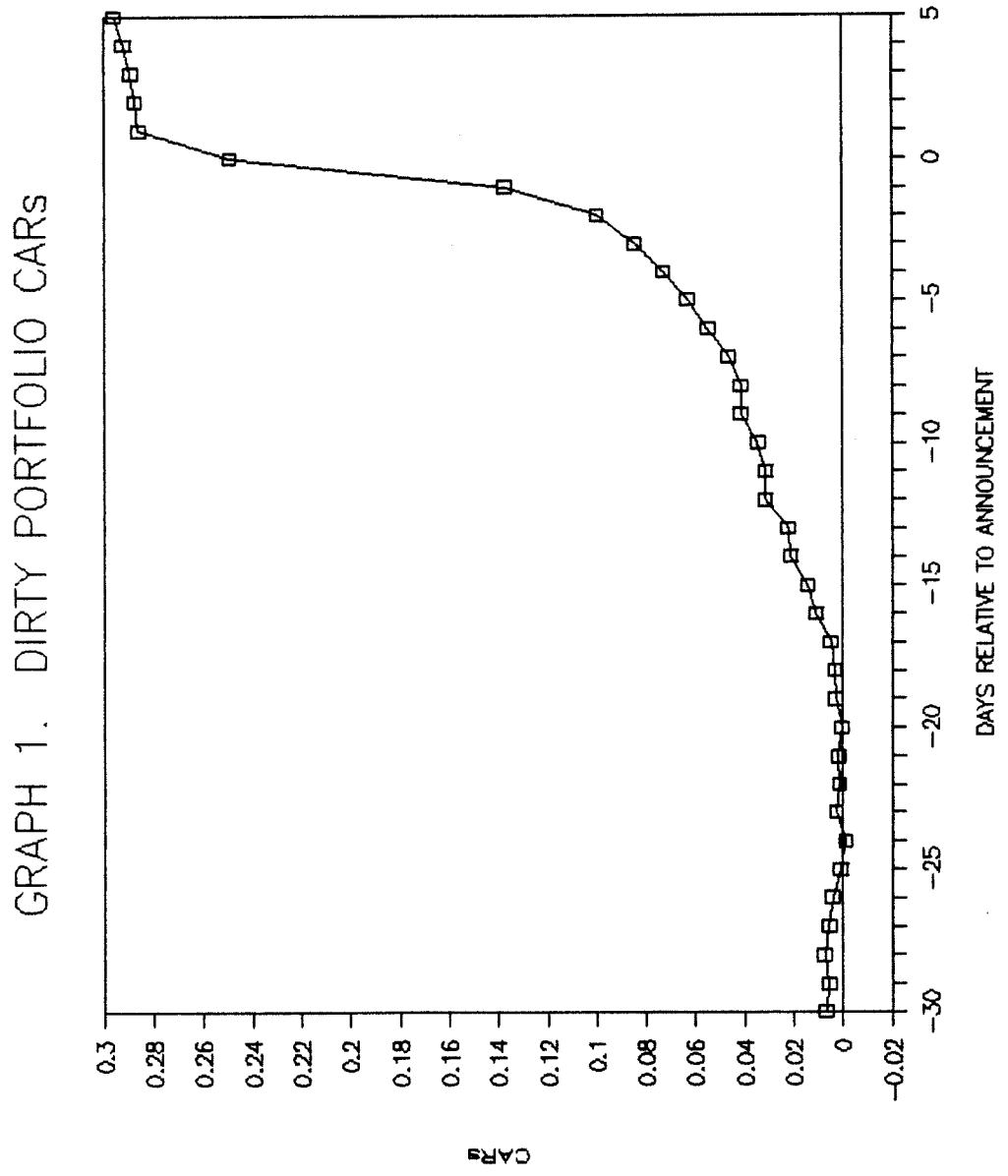
4.1.1. The "Dirty" Sample

In the 200-day estimation period, the "dirty" portfolio returns differ significantly[17] from the rest of the market on only 12 days (for 8 days, the returns are higher than the market, and for 4 days, the returns are significantly negative relative to the market). So for 188 days, the portfolio excess returns are not significantly different from zero. The cumulative abnormal return on day -31, the end of the estimation period, bears this out as it shows a cumulative return of less than 0.05 percent over the rest of the market. The market model, therefore, appears to accurately map the activity within the "dirty" portfolio up until one month prior to the announcement date.

These results change dramatically in the month prior to the announcements of the mergers. The event-window results appear in Table 4.1. The portfolio excess returns are positive for 28 out of the 36 days in the event window, and beginning on day -19, they are positive for all days except one (day -8). These positive returns are significantly different from zero for 15 out of the last 22 days in the event window, and they are consistently positive and significant from day -7 through day +1. Acumulating these excess returns reveals a pattern of rising returns beginning on day -23 and continuing throughout the remainder of the event window. This pattern is exhibited in Graph 1. By day +1, the "dirty" portfolio has outperformed the rest of the market by a cumulative excess return of 28.6 percent.

TABLE 4.1
DIRTY PORTFOLIO
EVENT PERIOD STATISTICS

DAY	AVERAGE EXCESS RETURN	CAR	RUNUP	STANDARDIZED EXCESS RETURN	STANDARDIZED TEST STATISTIC
-30	0.00674	0.00674	2.3532	0.26101	2.30816
-29	-0.00108	0.00566	1.9760	-0.06673	-0.59011
-28	0.00194	0.00759	2.6526	0.12920	1.14254
-27	-0.00195	0.00564	1.9714	-0.03989	-0.35275
-26	-0.00134	0.00430	1.5034	-0.05263	-0.46542
-25	-0.00324	0.00106	0.3717	-0.03758	-0.33233
-24	-0.00210	-0.00104	-0.3619	-0.08378	-0.74088
-23	0.00383	0.00277	0.9676	0.19465	1.72133
-22	-0.00129	0.00147	0.5135	-0.00278	-0.02458
-21	0.00054	0.00202	0.7056	0.00177	0.01565
-20	-0.00148	0.00054	0.1886	-0.04660	-0.41209
-19	0.00252	0.00306	1.0688	0.20469	1.81011
-18	0.00047	0.00353	1.2330	0.04615	0.40811
-17	0.00139	0.00492	1.7185	0.10584	0.93596
-16	0.00610	0.01102	3.8492	0.30556	2.70213
-15	0.00327	0.01429	4.9914	0.26836	2.37316
-14	0.00700	0.02130	7.4400	0.23256	2.05657
-13	0.00089	0.02218	7.7474	0.08783	0.77670
-12	0.00914	0.03133	10.9434	0.37948	3.35581
-11	0.00030	0.03163	11.0482	-0.03109	-0.27493
-10	0.00277	0.03439	12.0123	0.10796	0.95471
-9	0.00697	0.04136	14.4469	0.34790	3.07655
-8	-0.00001	0.04135	14.4434	-0.04609	-0.40758
-7	0.00517	0.04652	16.2493	0.22896	2.02474
-6	0.00841	0.05492	19.1833	0.38778	3.42921
-5	0.00820	0.06312	22.0476	0.44759	3.95812
-4	0.00974	0.07286	25.4497	0.57583	5.09217
-3	0.01181	0.08466	29.5714	0.68591	6.06563
-2	0.01546	0.10012	34.9715	0.77034	6.81226
-1	0.03724	0.13735	47.9758	2.07958	18.39012
0	0.11209	0.24944	87.1284	6.11217	54.05108
1	0.03685	0.28629	100.0000	1.83739	16.24839
2	0.00152	0.28781	100.5309	0.13856	1.22531
3	0.00178	0.28960	101.1562	0.18920	1.67313
4	0.00307	0.29267	102.2285	0.10599	0.93729
5	0.00360	0.29626	103.4825	0.07805	0.69021


GRAPH 1. DIRTY PORTFOLIO CARs
CARs
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-30
-25
-20
-15
-10
-5
0
5
DAYS RELATIVE TO ANNOUNCEMENT

Since all of this activity has occurred prior to the public announcements of the mergers, it confirms the substantial information leaks known to have occurred within the portfolio due to the illegal trades, but perhaps also includes some legitimate speculation as well. These results are entirely consistent with the previous event studies of target firms. For instance, Keown and Pinkerton's[18] sample of 194 mergers earns a day +1 CAR of 26.7 percent in excess of the market. The portfolio of 17 firms involved in the Antoniu-Newman case studied by Keown, Pinkerton, Young and Hansen[19] exhibit an even more extraordinary day +1 CAR of 33.99 percent which rises still higher to 40.29 percent on day +16.

4.2. The Timing of the Trades

By combining the event study results from the "dirty" sample with the information contained in the table of illegally-traded securities, an opportunity emerges to link the information uncovered through litigation with the economic data. Specifically, one can discover the degree to which the insiders' purchases are correlated with the stock price runups prior to public announcement. One would expect that if the insiders' trades are responsible for the huge stock price runups by disseminating the information of the mergers before they are publically announced, the dates of the insiders' trades should be closely linked to the beginning of the stock price runups. To see if this is indeed the case, the distribution of the insiders' trading dates is compared to the CAR results from the "dirty" portfolio.

The distribution of the trading dates is shown in Table 4.2 and shows that the insider information possessed by the defendants was, in general, not long-held secrets. The distribution is highly skewed to the left, as 80 percent of the trades occur within 14 days of the announcement, and 45 percent occur within 5 days of the announcement. Out of 124 known trading dates, the mean trading date of the insiders is between days -9 and -10 ($\bar{x}$ = -9.69). These results strongly support the finding by Keown and Pinkerton that 85 out of 194 of their mergers exhibited nonrandom trading patterns for the 12 days prior to announcement.

Testing the relation between the insider purchases and the stock price runups involves a simple hypothesis test to see if the average trading date is significantly different from the day that the stock price runup begins. The test statistic is simply:

TABLE 4.2. DISTRIBUTION OF TRADING DATES

Days relative to announcement	...-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	1	0
Frequency	25	4	4	3	2	3	3	7	6	12	7	14	7	6	9	12

25% 10% 25% 45%

total number of trades for which date-traded information is available: 124
mean trading date: -9.69 standard deviation: 12.34
median trading date: -6 mode trading date: -4

$$Z = \frac{\hat{\theta} - \theta_o}{s/\sqrt{n}},$$

where $\hat{\theta}$ = average trading date (mean=-9.69, median=-6 or mode=-4)
θ_o= day the runup begins (-23)
s = standard deviation of the trading day sample (12.34)
n = number of days in the trading day sample (124).

This statistic tests the hypothesis $H_o: \hat{\theta} = \theta_o$
$H_1: \hat{\theta} \neq \theta_o$.

The beginning of the runup is defined as the first day prior to the announcement date in which the CARs became significantly positive and remained so until the announcement. From the event-window results for the "dirty" sample reported above, the runup begins on day -23. The results of the test allow the rejection of the hypothesis: the average trading date is significantly different from the beginning of the CAR runup. The test statistic for the difference between the mean trading date and the first positive CAR is 12.011, far into the rejection region (for the median, the statistic is 15.34 and for the mode, 17.15). It appears, therefore, that the price movements are <u>not</u> initiated by the trades of the insiders.

The market is responding to the upcoming announcement substantially before the insiders can reveal the information through their trading. This is an extremely interesting result with several possible explanations. The insiders may simply be learning of the information and leaking it to others before they trade on it several days later. Limited data exist concerning when the insiders acquired their information, but the available data suggests that the insiders trade the same

day or the day after they learn of the news.

Significant legal speculation may also account for this result. It is, however, certainly hard to believe that mere speculators can systematically outperform the market based on an information set that is surely no better, and likely significantly worse, than that of actual insiders.

Another explanation is that other illegal traders with even better information than the SEC's defendants remain undetected. Again, however, the limited data of when the insiders acquired their information suggests that, in many cases, the defendants were involved in the meetings from which the transactions were born. With the significant number of cases involving fiduciaries, however, it is possible that a window of several days exists before the fiduciaries learn that a deal is being contemplated. The executives may simply get together and negotiate several days before they discuss the matter with their lawyers or before they call their bankers.

An alternative explanation is that the market, by assimilating vast amounts of information through the pricing mechanism, is even more efficient than many have considered. Whatever the explanation, it is certainly clear that the relationship between the insiders' trading and the stock price activity of their securities is much more complicated than initially supposed here anyway.

4.3. Significance of Illegal Insider Trading

Trading in merger targets can be quite profitable, but the stock price runups are not perfectly correlated with the information dissemin-

ation by the insiders. A most important question, therefore, remains to be answered: how pervasive is illegal trading prior to merger announcements? To provide a measure for quantifying illegal trading, this study compares the "clean" and "dirty" portfolios. The results of the "dirty" portfolio have been presented above, and the results of the "clean" portfolio will follow immediately.

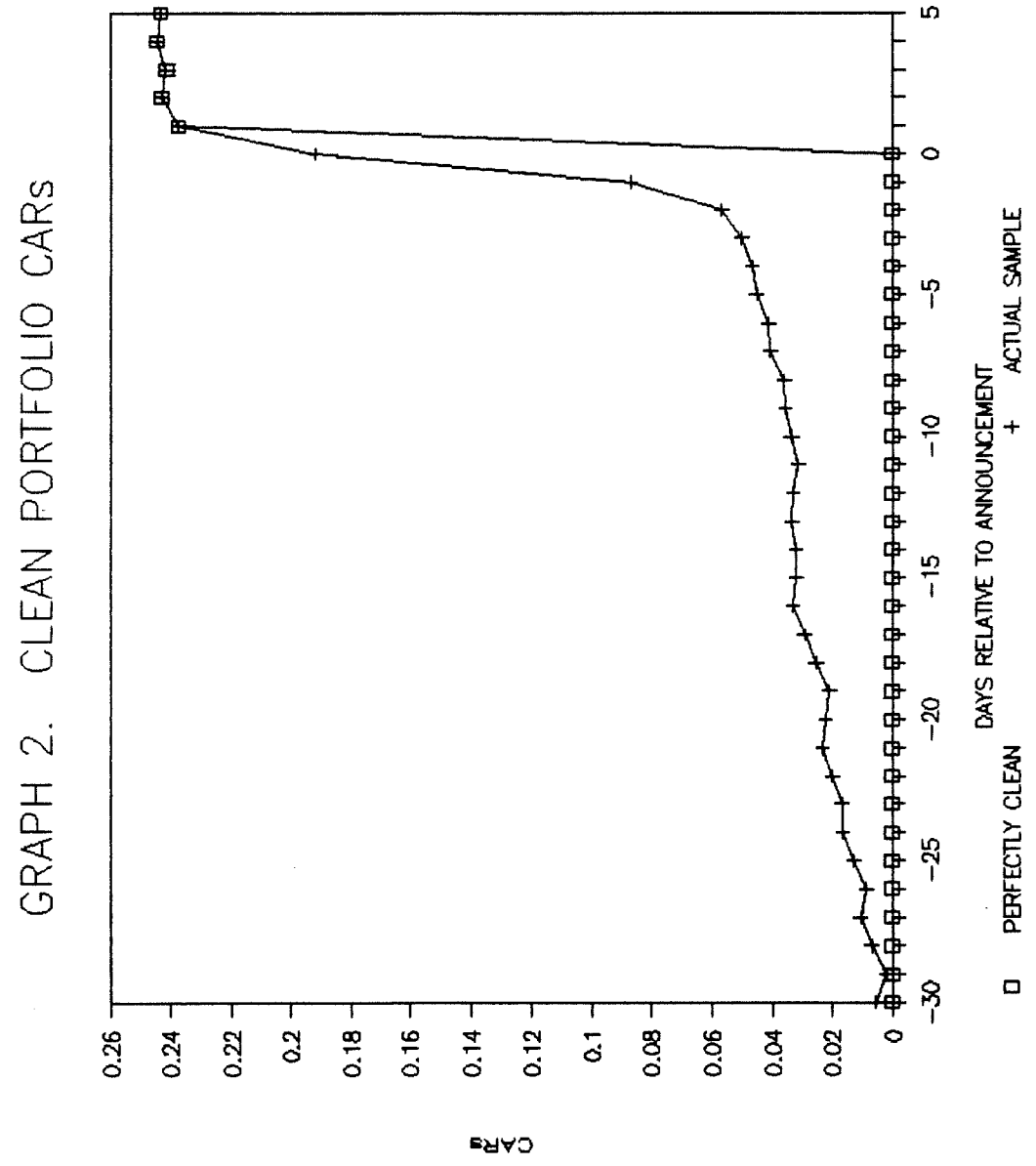
4.3.1. Comparison of the "Clean" and "Dirty" Portfolios

If the "clean" sample is truly clean, the event window results should show excess returns in the neighborhood of zero until the announcement date when they should shoot dramatically to the merger-value level. The actual results of the "clean" portfolio (Table 4.3) show that while the sample is relatively clean, significant pre-announcement price activity exists as well. The portfolio excess returns are positive for 27 of the 36 days in the event window, and they are consistently positive from days -10 through +2. These excess returns, however, are only significantly different from zero on 6 days: -30, -25, and the four days from -2 through +1. Therefore, up until two days before announcement, the "clean" portfolio behaves roughly as would be expected of a perfectly clean sample. For comparison, the "dirty" portfolio shows significantly positive returns for 18 days, and the returns are consistently positive five days earlier than the "clean" sample. Graph 2 compares the actual "clean" portfolio with the hypothetical results of a perfectly clean portfolio.

The real evidence of pre-announcement price activity in the "clean" portfolio appears in its cumulative abnormal returns. Accumulating the

TABLE 4.3
CLEAN PORTFOLIO
EVENT PERIOD STATISTICS

DAY	AVERAGE EXCESS RETURN	CAR	RUNUP	STANDARDIZED EXCESS RETURN	STANDARDIZED TEST STATISTIC
-30	0.00552	0.00552	2.3202	0.30851	2.72821
-29	-0.00359	0.00192	0.8076	-0.10327	-0.91324
-28	0.00478	0.00670	2.8167	0.10875	0.96170
-27	0.00366	0.01036	4.3557	0.12778	1.12998
-26	-0.00170	0.00866	3.6398	-0.05756	-0.50901
-25	0.00412	0.01277	5.3693	0.23443	2.07311
-24	0.00352	0.01629	6.8483	0.12796	1.13157
-23	0.00032	0.01661	6.9828	-0.05158	-0.45613
-22	0.00322	0.01984	8.3407	0.09417	0.83276
-21	0.00330	0.02314	9.7280	0.14028	1.24052
-20	-0.00094	0.02220	9.3328	-0.04544	-0.40183
-19	-0.00135	0.02085	8.7653	-0.10805	-0.95551
-18	0.00455	0.02540	10.6781	0.14229	1.25830
-17	0.00363	0.02903	12.2041	0.14433	1.27634
-16	0.00396	0.03299	13.8689	0.14914	1.31887
-15	-0.00108	0.03191	13.4149	0.03752	0.33180
-14	0.00026	0.03217	13.5242	0.04458	0.39423
-13	0.00131	0.03349	14.0791	0.01728	0.15281
-12	-0.00040	0.03309	13.9110	-0.04418	-0.39069
-11	-0.00186	0.03122	13.1248	-0.07925	-0.70082
-10	0.00250	0.03372	14.1758	0.06785	0.60001
-9	0.00195	0.03567	14.9956	0.13920	1.23097
-8	0.00028	0.03595	15.1133	-0.02754	-0.24354
-7	0.00469	0.04064	17.0850	0.15383	1.36035
-6	0.00063	0.04126	17.3456	0.03066	0.27113
-5	0.00385	0.04512	18.9683	0.13057	1.15466
-4	0.00131	0.04643	19.5191	0.02894	0.25592
-3	0.00357	0.05000	21.0199	0.11394	1.00759
-2	0.00669	0.05668	23.8281	0.23598	2.08682
-1	0.03016	0.08684	36.5073	1.33277	11.78594
0	0.10529	0.19214	80.7752	4.71942	41.73473
1	0.04573	0.23787	100.0000	1.40681	12.44069
2	0.00518	0.24305	102.1777	-0.18587	-1.64368
3	-0.00145	0.24159	101.5639	-0.43287	-3.82795
4	0.00312	0.24471	102.8755	-0.23792	-2.10397
5	-0.00124	0.24347	102.3542	-0.40798	-3.60784


GRAPH 2. CLEAN PORTFOLIO CARs
CAR's
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-30
-25
-20
-15
-10
-5
0
5
DAYS RELATIVE TO ANNOUNCEMENT
PERFECTLY CLEAN
ACTUAL SAMPLE

excess returns of the "clean" sample reveals a CAR pattern that is positive throughout the event window and, by day +1, the portfolio possesses a cumulative return of 23.79 percent, over 19 percent of which is registered on or before public announcement. This huge return either supports the SEC's belief of significant legitimate pre-annoucement activity or shows that this "clean" sample is not very clean afterall. Since it is impossible here to discover who actually traded on these firms and how much they knew, the cleanliness of the sample will remain unknown.[20]

Although the "clean" portfolio exhibits a tremendous cumulative return at the end of the event window, the pattern and timing of the returns differs substantially from the "dirty" portfolio. These differences can first be observed in the runup indices, the daily CARs measured as a percentage of the day +1 CAR. A comparison of portfolio runups measures relative changes in stock price activity and thus assumes that the profitability of both the "clean" and "dirty" mergers will be equal. This assumption is initially justified since no rationale exists to suggest that the illegal traders can isolate the profit potentials of various mergers and choose the most profitable ones. Additional tests, however, will relax this assumption.

Since the "clean" portfolio CARs are positive throughout the event window, their runup actually starts on day -30, seven days earlier than for the "dirty" portfolio. This result, of course, is opposite to what one would expect if the market was acknowledging information conveyed by well-informed insiders. This result, however, may not be so surprising when one is reminded that, at this point in the event window, the

majority of the defendants have not yet acquired, let alone traded on, their inside information. The "clean" portfolio's advantage is maintained until the last week before public announcement, roughly the time that most of the illegal trades were carried out. Six days before the announcement, the "clean" portfolio shows a runup of 17.4 percent, while the "dirty" portfolio has reached 19.2 percent of its day +1 value. By the day prior to the announcement, the "clean" runup is 36.5 percent compared to 47.9 percent for the "dirty" portfolio. For both portfolios, much of the merger-level value of the targets remains to be revealed, but the "dirty" firms are following a substantially more efficient path as would be expected if the market was now reacting to the activity of the defendants. The pattern continues even on the announcement day, as the respective runups are 80.8 percent and 87.1 percent for the "clean" and "dirty" portfolios.

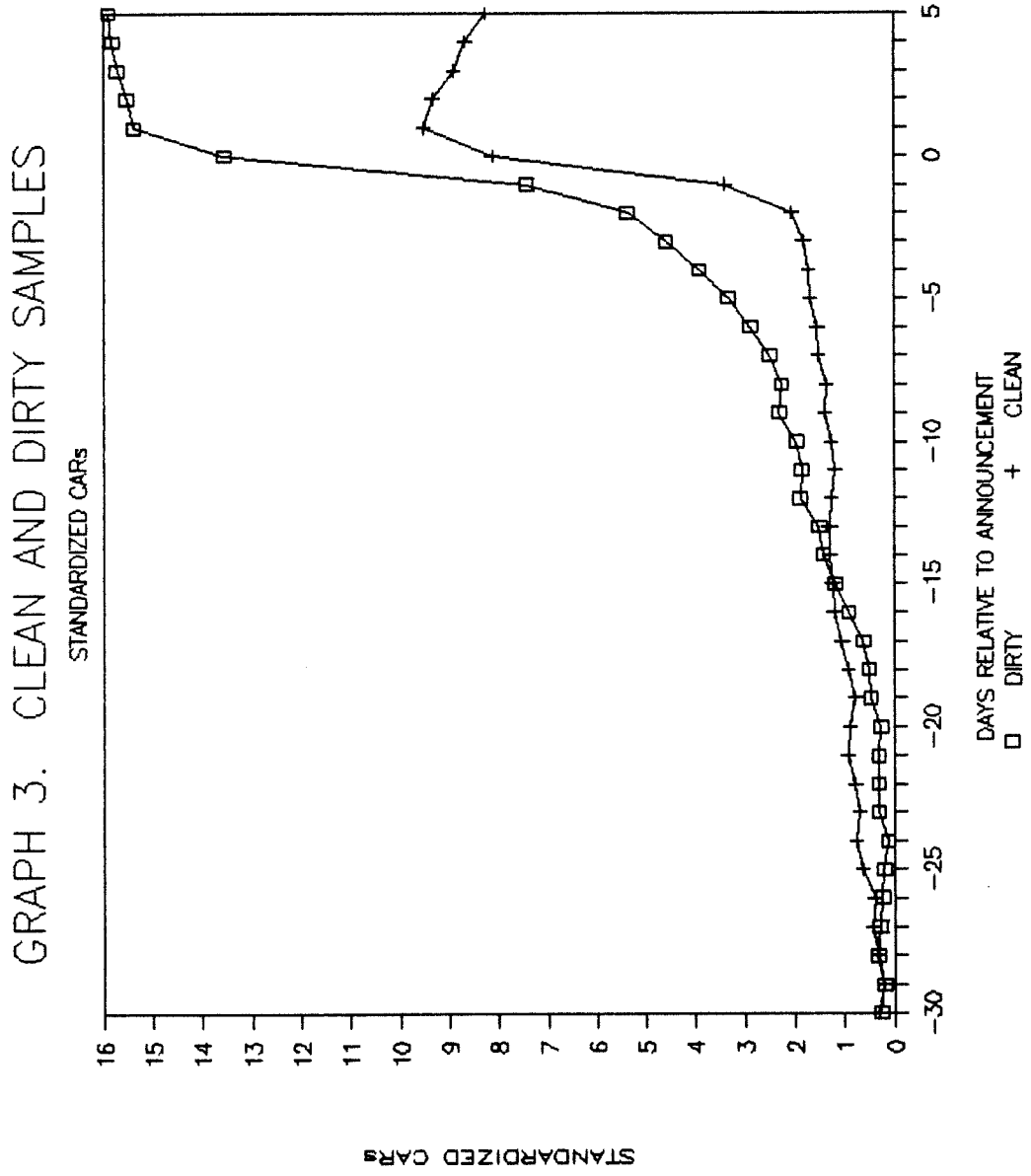
The difference-in-means test shows even more dramatically the superior efficiency of the "dirty" portfolio. The test results appear in Table 4.4 and are pictured in Graph 3. From days -27 until -16, the "clean" portfolio actually outperforms the "dirty" sample, and all of the differences are highly significant. This is substantially before most of the defendants have acted, but nonetheless, it is puzzling why the "clean" sample is significantly outperforming, rather than just performing on par with, the "dirty" portfolio. A noticeable switch, however, occurs between days -15 and -14, and for the rest of the event window, days -13 through +5, the "dirty" returns significantly outpace those of the "clean" sample. Thus over the time period that the defendants acted most prominently, the market appears to have responded

TABLE 4.4

STANDARDIZED CUMULATIVE ABNORMAL RETURNS IN THE EVENT WINDOW

(SAMPLE SIZE = 79)

DAY	STANDARDIZED CARs DIRTY	STANDARDIZED CARs CLEAN	CAR DIFFERENCE	TEST STATISTIC
-30	0.2610	0.3085	-0.0475	-1.7377
-29	0.1943	0.2052	-0.0110	-0.2835
-28	0.3235	0.3140	0.0095	0.2004
-27	0.2836	0.4418	-0.1582	-2.8934
-26	0.2310	0.3842	-0.1532	-2.5073
-25	0.1934	0.6186	-0.4253	-6.3513
-24	0.1096	0.7466	-0.6370	-8.8080
-23	0.3043	0.6950	-0.3908	-5.0543
-22	0.3015	0.7892	-0.4877	-5.9475
-21	0.3032	0.9295	-0.6262	-7.2447
-20	0.2566	0.8840	-0.6274	-6.9203
-19	0.4613	0.7760	-0.3146	-3.3229
-18	0.5075	0.9183	-0.4108	-4.1681
-17	0.6133	1.0626	-0.4493	-4.3928
-16	0.9189	1.2117	-0.2929	-2.7663
-15	1.1872	1.2493	-0.0620	-0.5672
-14	1.4198	1.2938	0.1260	1.1176
-13	1.5076	1.3111	0.1965	1.6945
-12	1.8871	1.2669	0.6202	5.2050
-11	1.8560	1.1877	0.6683	5.4672
-10	1.9640	1.2555	0.7084	5.6556
-9	2.3119	1.3947	0.9171	7.1534
-8	2.2658	1.3672	0.8986	6.8546
-7	2.4948	1.5210	0.9737	7.2713
-6	2.8825	1.5517	1.3308	9.7374
-5	3.3301	1.6823	1.6479	11.8228
-4	3.9060	1.7112	2.1948	15.4521
-3	4.5919	1.8251	2.7667	19.1281
-2	5.3622	2.0611	3.3011	22.4255
-1	7.4418	3.3939	4.0479	27.0367
0	13.5540	8.1133	5.4406	35.7482
1	15.3913	9.5201	5.8712	37.9698
2	15.5299	9.3343	6.1957	39.4562
3	15.7191	8.9014	6.8177	42.7745
4	15.8251	8.6635	7.1616	44.2857
5	15.9031	8.2555	7.6477	46.6297


GRAPH 3. CLEAN AND DIRTY SAMPLES
STANDARDIZED CARs
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-30
-25
-20
-15
-10
-5
0
5
DAYS RELATIVE TO ANNOUNCEMENT
□ DIRTY + CLEAN
STANDARDIZED CARs

to the superior information being conveyed to it.

Not only does the difference-in-means test show differences in the timing of the pre-announcement activity, but it also shows that the "dirty" portfolio is quite a bit more profitable than the "clean" portfolio at the end of the event window. The test relaxes the assumption made in the runup comparisons that the day +1 CARs for all samples should be the same. Instead, it provides an opportunity to test whether any differences at the end of the event window are significant. The difference between the "dirty" portfolio's 28.6 percent return and the "clean" sample's 23.79 percent turns out to be highly significant (t-statistic of 37.97), suggesting that as soon as the market has digested the announcement news, it values the "dirty" targets substantially more than "clean" targets. This may well signal that the early information dissemination caused by the illegal trades has triggered excessive trading in these targets causing them to be overvalued even for their merger-level values.

4.3.2. Implications

The comparison of the samples shows substantial differences between the illegally-traded targets and those not involved in litigation. If the actions of the defendants in the latest insider trading cases did not influence the pre-announcement prices of the targets, no differences should have surfaced. The differences uncovered are not only quite significant, but they are in the anticipated direction--the "dirty" CARs being greater than the "clean" CARs--over the time period when the majority of the defendants carried out their trades.

In some sense, there is a danger that finding substantial differences between the "clean" and "dirty" portfolios merely reinvents the wheel: the SEC may have decided to act against the defendants on the basis of these very differences. Uncovering the differences would then simply reveal what the SEC had previously seen. The danger, though, is not really consequential given the nature of SEC investigations. The exchanges report all unusual and significant stock blips and the SEC then investigates each one for questionable trading patterns. Beyond this initial phase, decisions to proceed with investigations of specific individuals depends not on the aggregate stock activity, but rather on audit trails from the exchanges, bank records, brokerage account records, and the testimony of witnesses. While insider trading cases are oten based on circumstantial evidence, aggregate stock price movements would seem a little too flimsy. The evidence must be of sufficient specificity to pose a threat to the defendant and to satisfy the minimum requirements of the judge or jury for a prima facie case. No real reason, therefore, exists to suspect that the CAR differences themselves led to the litigation.

4.4. A Measure of the Significance of Illegal Insider Trading

To the extent that the controls placed on all the samples allow illegal trading activity to explain the significant differences observed between the "clean" and "dirty" portfolios, an estimate of the significance of illegal insider trading can be formulated. The measure is merely a modification of the Lorenz curve and Gini-coefficient analysis used originally to measure the equality of income distributions. A

Lorenz curve shows as a continuous function the percentage of total income accounted for by any given fraction of a nation's population. This curve is compared to an equality line, the Lorenz curve that would exist if everyone in the country had the same amount of income. The Gini-coefficient is a numerical representation of the Lorenz curve and expresses the difference between the actual Lorenz curve and the equality curve as a percentage of the area under the equality curve.

If the "clean" portfolio was perfectly clean, it would exhibit a CAR pattern of consistent zeros until the announcement date as was shown in Graph 5. One could then assume that the entire area under the "dirty" CAR graph represented activity stemming from illegal activity. Since this study supports the SEC's findings to the extent that perfectly clean control samples were not found, the real impact of illegal activity is not the entire area under the CAR graph, but only the difference between the "dirty" and "clean" CARs. Analogizing the "dirty" CAR pattern to the equality line and the "clean" CAR pattern to the actual Lorenz curve provides the measure of the significance of illegal trading.

Slightly differently from Lorenz curve analysis, the data from the stock market are not actually continuous, but contain returns as of the close of each trading day. Further, the CAR graphs are not easily integrable functions. The measure of illegal insider trading, therefore, is discrete, rather than continuous, and it will be found by summing the daily differences in the standardized CARs. Analogous to a Gini-coefficient, these summed differences will be expressed as a percentage of the sum of the standardized "dirty" CARs over every day in

the event window.

The measure will take on a value between 0 and 1. A value of 0 denotes no difference between the "clean" and "dirty" CARs, and thus illegal insider trading would have no appreciable affect on the price activity of target firms. A value of 1 would confirm that all pre-announcement activity derives from the illegal trades. Summing the differences for the samples yields a Gini value of .3845. Illegal activity is, therefore, responsible for approximately 38 percent of the pre-announcement price activity of target firms. While a value of 0 would question whether shareholders really were significantly harmed by the actions of insiders, a result of 38 percent shows that the insiders do substantially influence the targets' stock prices. On the other hand, if damages in shareholder suits are calculated essentially by assuming the defendants are responsible for all of the pre-announcement activity, these damages may well be overstated.

For several reasons, this measure of illegal trading will be a conservative estimate. Most obviously, the "clean" sample may include tainted trades, and thus may not be as clean as possible. Further, by summing over all days in the event windows, the early days when the "clean" CARs actually dominate are included, and these negative differences partially offset the differences when the "dirty" firms actually take over.[21] Considering these factors then, the measure of illegal insider trading is a floor-value--at least 38 percent of the pre-announcement price activity derives from the illegal trades. This result, therefore, is entirely consistent with the SEC findings that legitimate factors account for at least one-third of the price move-

ments.

Section 5. Conclusion

This study presents evidence about the effects of illegal insider trading by combining resources obtained from the recent insider trading cases with an economic analysis of the stock market. Legal research led to the creation of a portfolio of merger and acquisition targets traded illegally between 1980 and 1987. Techniques from the field of finance were then employed to study the stock returns of the tainted securities. Even though illegal trading occurs around numerous types of events, the number of cases involving merger targets implies that such targets are a valuable source of information about insider trading.

By focusing on the defendants in the recent insider trading cases, this study can examine the efficiency of the market as well as the characteristics of illegal insider trading. This is because the defendants, like the corporate insiders, possessed superior information relative to other investors. Evidence is presented in this study which tends to show the that the market is semi-strong efficient. Significant differences were found between the portfolio of illegally-traded securities and a control sample of target firms not involved in insider trading litigation. In general, the "dirty" firms dominated with higher cumulative returns appearing sooner than for the control sample. The market, therefore, does not react to all available information as would a strongly efficient market, but it does seem to react to the nonpublic information revealed through the trades of the defendants.

The efficiency hypothesis also suggests that the market should adjust quickly to all publicly available information, so differences between portfolio returns after the announcement date should be insignificant. No reason exists to initially suspect that some portfolios of targets should be more profitable than others or, even that if they are, that the defendants could have chosen to be better informed about these particular transactions. Certain portfolio comparisons nonetheless exhibit highly significant differences between the post-announcement cumulative returns, which may well be evidence of price manipulation.

Significant differences appear between the "dirty" sample and the control sample as of the announcement date. The trades by the defendants are much more profitable on day +1 than the "clean" trades, showing cumulative returns on day +1 of 28.6 and 23.8 percent respectively. The excessively large returns in the "dirty" portfolio may be explainable by overreaction in the market to the trading of the insiders, pushing the returns above even the merger-level market value of the targets.

Another interesting puzzle uncovered concerns the timing of the defendants' trading relative to the pre-announcement price activity of their securities. The complaints filed by the SEC yield a highly-skewed distribution of trading dates with 80 percent of the activity occurring within the 14 days preceeding the merger announcements. Over half of the trades occurred within 10 days of public announcement. Despite this, the "dirty" portfolio shows significant pre-announcement activity occurring well before most of the defendants acted. Such differences may represent legitimate speculation or may derive from the activity of

undetected insiders.

Although the insiders' trading dates do not match up with the price movements in the "dirty" portfolio, they are closely related to the point when the "dirty" portfolio returns significantly surpass those of the "clean" sample. These differences, aside from providing information about the dissemination of information and the efficiency of the market, display the impact of illegal trading on the market. Using techniques analogous to those for measuring the equality of income distributions, this study suggests that illegal activity is responsible for at least 38 percent of the pre-announcement price runups of the illegally-traded merger and acquisition targets.

By investigating further the growing number of insider trading cases, the methodology and data presented here can be further refined to yield even more accurate results about the nebulous underground activity of insider trading. Only when we truly understand the nature of the crime and its impact on the stock market can we address the problem of the costs and benefits of the laws and their enforcement and determine how the SEC, Congress, and the financial community should best handle the problem.

NOTES

1. Insider Trading: Hearing before the Subcomm. on Telecommunications, Consumer Protection and Finance of the House Comm. on Energy and Commerce, 99th Cong., 2d Sess. 1 (1987) (statement of John S. Shad, then chairman of the Securities Exchange Commission).

2. Poulson and Jarrell, Stock Trading Before the Announcement of Tender Offers: Insider Trading or Market Anticipation?, a study by the Office of the Chief Economist, Securities and Exchange Commission, 24 February 1987.

3. See, e.g., the testimony of ex-chairman Shad in Insider Trading, supra note 1, at 40.

4. See O'Brien, Illegal Insider Trading and Information Dissemination (January 1990) (unpublished manuscript).

5. 15 U.S.C. § 78 (i), (j), (m), (n), and (p). § 16(a) defines "insiders" as "direct or indirect beneficial owners" of more than 10 percent of any class of registered equity security, or a director or officer of a company with registered securities. This subsection also requires these insiders to report any transactions within ten days after the end of the month in which it occurs. §§ 9 and 10 actually provide the restrictions on what is popularly referred to as "insider trading." § 9(e) threatens potential civil liability for anyone who "willfully participates" in deceptive and manipulative activity of securities on national exchanges. § 10 expressly states what acts are unlawful. §§ 13 and 14 of the act, as amended in 1968 under the Williams Act, deal exclusively with tender offers. § 13 establishes very strict disclosure requirements by those intending corporate control maneuvers. Under § 13(d), any person acquiring securities making him a 5 percent beneficial owner must file a report with the SEC within ten days of the purchase and must also state the reasons for the purchase. § 14 parallels § 10 in that it spells out exactly what is deemed illegal in terms of tender offer manipulations.

6. These are the "insiders" as defined by § 16 of the Securities and Exchange Act.

7. The following is a partial list of the economic studies which rely upon the Official Summary as a source for insider trading: Allen, The Response of Insider Trading To Changes in Regulatory Standards (July 1986) (unpublished manuscript); Finnerty, Insiders' Activity and Inside Information: A Multivariate Analysis, 11 Journal of Financial and Quantitative Analysis 205 (1976), and Insiders and Market Efficiency, 31 Journal of Finance 1141 (1976); Jaffe, The Effect of Regulation Changes on Insider Trading, 5 Bell Journal of Economics and Management Science 93 (1974), and Special Information and Insider Trading, 47 Journal of Business 410 (1974); Penman, A Comparison of the Information Content of Insider Trading and Management Earning Forecasts, 20 Journal of Financial and Quantitative Analysis 1 (1985), and Insider Trading and the Dissemination of Firms' Forecast Information, 55 Journal of Business 479 (1982); Seyhun, Insiders' Profits, Costs of Trading, and Market Efficiency, 16 Journal of Financial Economics 189 (1986), and The Information Content of Aggregate Insider Trading, 61 Journal of Business 1 (1988); and Rozeff and Zamen, Market Efficiency and Insider Trading: New Evidence, 61 Journal of Business 25 (1988). Two studies concentrate on major corporate events for insider trading information and are critical of the Official Summary as a data source: Elliott, Morse and Richardson, The Association Between Insider Trading and Information Announcements, 15 The Rand Journal of Economics 521 (1984); and Givoly and Palmon, Insider Trading and the Exploitation of Inside Information: Some Empirical Evidence, 58 Journal of Business 69 (1985). Finally, three studies actually utilize merger data rather than the Official Summary for information on insider trading: Keown and Pinkerton, Merger Announcements and Insider Trading Activity: An Empirical Investigation, 36 Journal of Finance 855 (1981); Keown, Pinkerton, Young and Hansen, Recent SEC Prosecutions and Insider Trading on Forthcoming Merger Announcements, 13 Journal of Business Research 329 (1985); and Poulson and Jarrell, supra note 2.

8. Carlton and Fischel, The Regulation of Insider Trading, 35 Stan. L. Rev. 857, 886-7 (1983).

9. Insider Trading, supra note 1, at 8.

10. Another recent study also notes the dimensions of the insider trading for the purpose of "correcting such misunderstandings" that have resulted from "the failure to distinguish various sorts of violations from one another." Haddock and Macey, Regulation on Demand: A Private Interest Model, With an Application to Insider Trading Regulation, 30 Journal of Law and Economics 311, n. 1 (1987) While running the risk of lumping the various dimensions back together, this author feels the generalized definition is advantageous for two reasons: most, if not all, of the recent cases discussed herein involved prosecutions under both §§ 10 and 14. Further, all three forms of insider trading theoretically affect the stock market in exactly the same way--they release information to the market which allows the market price to adjust to the true value.

11. See e.g., the studies supra note 3.

12. See: Dodd, supra note 3; Asquith, Merger Bids, Uncertainty, and Stockholder Returns 11 Journal of Financial Economics 51 (1983); and Asquith, Bruner and Mullins, The Gains to Bidding Firms from Merger, 11 Journal of Financial Economics 121 (1983).

13. Daily stock return data for all firms in this study are provided by the Center for Research in Securities Prices.

14. Developed in Fama, Fisher, Jansen and Roll, The Adjustment of Stock Prices to New Information, 10 International Economic Review 1 (1969).

15. This assumption, like most economic assumptions, may not be valid. The efficiency of the stock market is currently a hotly debated subject. The consensus of the Official Summary studies of insider trading, supra Part 1, note 4, however, suggests that this assumption is reasonably accurate.

16. To name only two of many: Dodd, Merger Proposals, Management Discretion, and Stockholder Wealth, 8 Journal of Financial Economics 105 (1980); and Keown and Pinkerton, supra Part 1, note 15.

17. At a significance level of 90 percent or better. This will be the criterion consistently used throughout the paper when referring to significance tests.

18. Supra note 6.

19. Supra note 6.

20. I recently had an opportunity to discuss the methodology of this study with numerous corporate attorneys. Every lawyer conveyed skepticism about the possibility of finding a "clean" portfolio since so many different individuals are involved in every merger or acquisition. If they are correct, then actually finding any differences between the "clean" and "dirty" samples will be that much more significant.

21. By summing over only those days where the results are positive and when the defendants traded most heavily, the Gini value for the measure of insider trading increases only to 44.05 percent of the pre-announcement price activity.

APPENDIX A

INSIDER TRADING DEFENDANTS
FROM THE JANUARY 1986--JUNE 1989 CASES

William Adams
Samuel Aksler
Adrian Antoniu
Richard Bastien
Paul Bilzerian
Ivan Boesky
John J. Borer
David S. Brown
David Carpenter
Randall Cecola
Robert Chestman
John Naylor Clark
Geoffrey Collier
Joseph Cremonese
Michael David
Robert D'Elia
Anthony DePalma
Harvey Alan Doliner
Russell Douglas
Drexel Burnham Lambert
Alfred Elliott
First Boston Corp.
James F. Flaherty
Anthony Franco
Israel Grossman
Thomas Hartnett
David Hellberg
David Henderson
Kerry A. Hurton
Marvin Hayle Ingram
Mario Iseppi
Carl Karcher
Marcel Katz
Darius Keaton
Kidder Peabody & Co., Inc.
Alfred Kopfmann
Dennis Levine
Martin Lewis
John Lombardi
Manohar Lal Madan
Marcus Schloss & Co., Inc.
Morgan F. Moore
Dominick Musella
John S. Newton
Charles Offer
Douglas Patty
Don S. Peters
Melvin Pomerantz
Ilan Reich
Frank Rummonds
Martin Siegel
Joseph Sierchio
Ira Sokolow
Guiseppe Tome
Nahum Vaskevitch
Stephen Sui-Kuan Wang
Robert Wilkis
William Wolski

APPENDIX B

MATHEMATICAL PRESENTATION OF THE EVENT STUDY AND STATISTICAL TESTS

Uncovering evidence of insider trading requires comparisons between the daily returns of the "clean" and "dirty" portfolios. These comparisons involve estimating daily excess returns for each firm over an estimation period and forecasting daily excess returns over an event window. The event window is defined as the 30 days prior to the announcement date through the fifth day after announcement, and the estimation period runs for the 200 days preceding the event window. To calculate these daily excess returns, the OLS market model proposed by Fama, et al.* is utilized:

$$R_{i\tau} = \alpha_i + \beta_i R_{m\tau} + \varepsilon_{i\tau}, \quad i = 1,\ldots,N$$
$$\tau = -231,\ldots,-31$$

$R_{i\tau}$ $\equiv$ the return of firm i on day τ
α_i, β_i $\equiv$ model parameters for firm i
$R_{m\tau}$ $\equiv$ the return on the market portfolio
$\varepsilon_{i\tau}$ $\equiv$ the residual for firm i on day τ
N $\equiv$ the number of firms in the portfolio.

$\varepsilon_{i\tau}$ measures any abnormal returns unique to firm i and that are not explainable by marketwide conditions. Allowing for the possibility of

---

* Developed in Fama, Fisher, Jensen and Roll, The Adjustment of Stock Prices to New Information, 10 International Economic Review 1 (1969).

cross-sectional variances, the error assumptions are:

$$\begin{aligned} E(\varepsilon_{i\tau}) &= 0 \\ E(\varepsilon_{i\tau},\varepsilon_{j\theta}) &= \sigma_i^2 \quad \text{for } i=j \text{ and } \tau=\theta \\ &= 0 \quad \text{for } i\neq j \quad \text{or } \tau\neq\theta. \end{aligned}$$

The estimated daily excess returns for each firm are computed using the following equation:

$$\hat{\varepsilon}_{i\tau} = R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau}.$$

If the ideal conditions hold, $\varepsilon_{i\tau} \sim N(0,\sigma_i^2)$, and the standardized firm excess return is

$$\varepsilon^*_{i\tau} = \frac{\varepsilon_{i\tau}}{\sigma_i} \sim N(0,1).$$

Utilizing the estimation-period parameters, the excess returns for the event window are

$$\hat{\mu}_{i\theta} = R_{i\theta} - \hat{\alpha}_i - \hat{\beta}_i R_{m\theta}, \quad \begin{aligned} i &= 1,\ldots,N \\ \theta &= -30,\ldots,+5. \end{aligned}$$

The actual forecast error will then be distributed $\mu_{i\theta} \sim N(0,\sigma_i^2 C_{i\theta})$, where $C_{i\theta}$ reflects the added variance due to forecasting uncertainty, and is calculated as

$$C_{i\theta} = 1 + \frac{1}{T} + \frac{(R_{m\theta} - R_m)^2}{\sum_{\tau}(R_{m\tau} - R_m)^2}, \quad \tau = -200, \ldots, -31, \quad \theta = -30, \ldots, +5,$$

and where $R_m = \frac{1}{T} \sum_{\tau=-231}^{-31} R_{m\tau}$.

Standardizing $\mu_{i\theta}$ yields

$$\mu^*_{i\theta} = \frac{\mu_{i\theta}}{\sigma_i \sqrt{C_{i\theta}}} \sim N(0,1).$$

Averaging the standardized daily excess returns over all firms in the portfolio yields the portfolio standardized daily excess returns in the estimation period and the event window:

$$\bar{\varepsilon}^*_{\tau} = \frac{1}{N} \sum_{i=1}^{N} \varepsilon^*_{i\tau} \quad \text{and} \quad \bar{\mu}^*_{\theta} = \frac{1}{N} \sum_{i=1}^{N} \mu^*_{i\theta}.$$

Both are distributed $N(0, \frac{1}{N})$. These portfolio standardized daily excess returns are tested for significance with the following Z-statistics calculated similarly to that of Patell (1976)**:

**Patell, Corporate Forecasts of Earnings per Share and Stock Price Behavior: Empirical Tests, 14 Journal of Accounting Research 246 (1976).

$$Z_\tau = \bar{\varepsilon}^*_\tau \cdot \left[N \cdot \frac{196}{198}\right]^{\frac{1}{2}} \quad \text{and} \quad Z'_\theta = \bar{\mu}^*_\theta \cdot \left[N \cdot \frac{196}{198}\right]^{\frac{1}{2}}.$$

The derivation of these particular Z-statistics is as follows. From above, we know that the standardized daily excess return is distributed N(0,1/N), or rearranging slightly,

$$\bar{\mu}^*_\theta \sqrt{N} \sim N(0,1).$$

Using the estimated variance, $\frac{1}{N} \sum_{i=1}^{N} \frac{\hat{\varepsilon}_{i\tau}}{s_i} \sim t(T-2)$. Each t-statistic statistic has an expected value of 0 and a variance of $\frac{T-2}{T-4}$. Assuming the standardized daily excess returns are independent random variables with the above distribution, a normalized sum can be formed:

$$Z'_\theta = \frac{\bar{\mu}^*_\theta \sqrt{N}}{\left[\frac{T-2}{T-4}\right]^{\frac{1}{2}}}$$

where T is the number of days in the estimation period. Rearranging slightly gives the statistic provided above. Z_τ is identically derived.

Z_τ and Z'_τ are asymptotically N(0,1). The statistics test the hypotheses of whether or not the daily portfolio excess returns differ

from zero. If the market fully explains price movements in the portfolio, one could not reject the hypothesis that

$$H_0: \quad E(\bar{\mu}^*_\theta) = 0$$
$$H_1: \quad E(\bar{\mu}^*_\theta) \neq 0 \text{ (greater or less than)},$$

and a similar test holds for $\bar{\varepsilon}^*_\tau$.

To discern the significance of illegal insider trading prior to announcement, the cumulative abnormal returns for each portfolio are calculated by summing over time the portfolio excess returns:

$$CAR_\tau = \bar{\varepsilon}_\tau + CAR_{\tau-1} \text{ for the estimation period, and}$$
$$CAR_\theta = \bar{\mu}_\theta + CAR_{\theta-1} \text{ for the event window.}$$

As with the daily portfolio excess returns, the daily CARs can also be tested for significance. The standardized CARs are the sums of the standardized daily excess returns, and thus possess the following distribution:

$$CAR^*_\theta = \sum_{\theta=1}^{\theta} \bar{\mu}^*_\theta \sim N(0, \frac{\theta}{N}),$$

where θ is the number of days being accumulated. The estimated variance for the standardized CARs is $\frac{\theta}{N} \cdot \frac{T-4}{T-2}$, so the test statistic becomes

$$W_{\Theta} = \mu_{\Theta} \cdot \left[\frac{N(T-2)}{\Theta(T-4)}\right]^{\frac{1}{2}}.$$

The hypothesis test is similar to those of the daily excess returns, but it tests the significance of the cumulative pattern of excess returns. If the market accurately explains the activity within the portfolio, the excess returns should average to, and the cumulative pattern of returns should hover around, zero. One should, therefore, not be able to reject

$$H_0: \quad E(CAR_{\Theta}^{*}) = 0$$
$$H_1: \quad E(CAR_{\Theta}^{*}) \neq 0 \text{ (greater or less than).}$$

Based upon the previous merger research one certainly expects to reject this hypothesis for the days prior to the announcement, especially if the stocks are tinged with illegal trades or even subject to significant (legal) speculation. This test should, therefore, provide additional supporting evidence about return runups prior to announcement at least in the "dirty" portfolio, but perhaps also in the "clean" portfolio.

The semi-strong efficiency hypothesis implies that for illegally traded stocks more (accurate) information is known by the market sooner, so the true value of the target firms should be revealed sooner. To apply this idea, the CAR's will be used first to examine stock runups and then to calculate a difference-in-means hypothesis test between the clean and dirty portfolios. The notion of semi-strong market efficiency implies that by day +1, the market will have fully adjusted to the

merger announcement. Thus all gains after day +1 should denote real value gains above the value that pre-announcement speculators placed upon the transaction. To observe how quickly the portfolio returns adjust to the post-announcement true value, a runup index is calculated:

$$\text{Daily Runup} = \frac{CAR_{\Theta}}{CAR_{+1}} \cdot 100, \ \Theta = -30,\ldots,+5.$$

Comparing the patterns of the CARs and the runup indices between the "clean" and "dirty" portfolios, and utilizing the semi-strong efficiency hypothesis, one should uncover information about the significance of illegal insider trading. One expects to find that the runup should be more complete sooner if illegal trading is conveying information to the market than if the information remains undisclosed.

A more important test involves statistically comparing the event-window CARs of the "clean" and "dirty" portfolios with a difference-in-means test statistic. Rather than simply measuring and comparing the percentages of runup completed for each day, this test actually measures the daily differences in CAR patterns between the "clean" and "dirty" portfolios. If the market efficiency hypothesis is correct, the "dirty" portfolio should reveal information to the market causing the pre-announcement price patterns discovered in previous research, whereas a truly "clean" portfolio should consistently hover around zero. Poulson and Jarrell, however, suggest that, due to legitimate factors, "clean" portfolios should also possess patterns of rising runups prior to announcement. Nonetheless, the quality of information should be higher

among the illegally traded stocks, causing the pattern of CARs to differ between the "clean" and "dirty" portfolios. Seeing if such a difference exists will be a start to quantifying the significance of illegal insider trading on merger transactions.

Since the portfolios are calculated over the same size event window, the difference-in-means test simplifies to

$$Z'' = \frac{CAR_{\Theta}^{dirty} - CAR_{\Theta}^{clean}}{\left[\frac{\Theta}{\left[N \cdot \frac{198}{196}\right]}\right]^{\frac{1}{2}} \cdot \left[\frac{2}{36}\right]^{\frac{1}{2}}}.$$

Z" is derived as follows. A normal difference-in-means statistic has the following form:

$$Z = \frac{CAR_{\Theta}^{d} - CAR_{\Theta}^{c}}{S \cdot \left[\frac{1}{N^{d}} + \frac{1}{N^{c}}\right]^{\frac{1}{2}}}.$$

S is the weighted standard deviation such that

$$S^2 = \frac{{}^{d}S^2(N^{d}-1) + {}^{c}S^2(N^{c}-1)}{N^{d} + N^{c} - 2},$$

where N^{d} and N^{c} are the number of days in the event window. Since the

portfolios have the identical number of firms, the same size event windows, and the variances are the same (so $S_d^2=S_c^2=S^2$), the denominator reduces to

$$S \cdot \left[\frac{2}{36}\right]^{\frac{1}{2}}.$$

From the distribution for CARs, $S = \dfrac{\theta}{N \cdot \dfrac{T-2}{T-4}}$,

where, again, θ = the number of days being accumulated.

Z" is asymptotically N(0,1) for large N and is used to test the following hypothesis:

$$H_o: \quad CAR_\theta^{dirty} - CAR_\theta^{clean} = 0$$
$$H_1: \quad CAR_\theta^{dirty} - CAR_\theta^{clean} \neq 0$$

The semi-strong efficiency hypothesis, coupled with the presumed superiority of illegal traders' information set, would suggest that the null be rejected, signifying a significant difference of the "dirty" portfolio over the "clean."