

Shock effects on stocks, bonds, and exchange rates

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Abstract

Tick data and newswire searches are used to find events that led to large and rapid price changes in a stock future, a bond future, and three exchange rate futures. Knowledge of these events may be useful in future work. They have the advantages that they are truly surprises and that the sign of their effect on each financial instrument is known. The events are used in this study to analyze the effects of three types of events (monetary, price, and real) on the five instruments.

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1. Introduction

Announcements and other events have from time to time large and rapid effects on stock and bond prices and on exchange rates. Tick data on the S&P 500 futures contract and newswire searches were used in Fair (2002) to find 69 events between 1982 and 1999 that led to a one-to five-min price change greater than 0.75% in absolute value. In this paper 152 additional events have been found that led to such a change in either the S&P 500 future, a bond future, a deutsche mark (euro beginning 1999) future, a yen future, or a British pound future. Tick data and newswire searches were also used for this work. Section 2 discusses the data, and Section 3 discusses the procedure used to find the events.

Once the events have been found, the relationships among stock prices, bond

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prices, and exchange rates can be examined. Each event led to a large and rapid change in at least one of the variables, and it is of interest to see how each variable was affected by the change and whether systematic relationships can be found. The advantage of using the events to examine relationships is that the signal to noise ratio is very high. For each event the many other things that affect the relationships among the variables are swamped by the event, and so these other things are in effect held constant. Section 4 examines the relationships.

It will be seen in Section 3 that many of the events that were found are US macroeconomic announcements. There are a number of studies that have examined the effects of announcements on daily changes in stock prices. These include Schwert (1981), Pearce and Roley (1985), Hardouvelis (1987), Cutler et al. (1989), Haugen et al. (1991), McQueen and Roley (1993), and Boyd et al. (1999). Jain (1988) examined the change in stock prices from the close of trading on the day before an announcement to the first hour of trading after the announcement. In an early study Niederhoffer (1971) examined the effects of world events on daily stock prices.

Aside from Fair (2002), there are no studies that have examined the effects of announcements or other news events on US stock prices within the same day. The closest studies are those of Mitchell and Mulherin (1994) and Berry and Howe (1994), who examine the effects of the amount of news per unit of time on stock prices and trading volume. Other studies of intraday stock prices include Wood et al. (1985), who examine the behavior of a minute-by-minute market return index, French and Roll (1986), who examine the volatility of individual stock prices during trading and non trading hours, and Harris (1986), who examines the behavior of portfolio returns over 15-min intervals.

There are, however, studies examining the effects of macroeconomic announcements on intraday changes in bond prices, exchange rates, and UK stock prices. Ederington and Lee (1993) use tick data for the November 7, 1988–November 29, 1991 period to examine one-minute changes in the US Treasury bond future, the DM future, and the Eurodollar future. In Ederington and Lee (1995) 10-sec changes are examined. They find that most of the price reaction to an announcement occurs within the first minute. Becker et al. (1995b) examine 30-min changes in the UK FTSE-100; Becker et al. (1995a) examine 15-min changes in US, UK, German, and Japanese interest rates; and Becker et al. (1996) examine 15-min changes in the US Treasury bond future and the Eurodollar future.

Fleming and Remolona (1997) examine five-min price changes for the five year US Treasury note for the period August 23, 1993–August 19, 1994. They examine the 25 largest absolute five-min price changes over this period and find that each of these changes was preceded by a macroeconomic announcement. Jones et al. (1998) examine daily returns on 5, 10, and 30 year bonds for the 1979–1995 period. Almeida et al. (1998) use quotation data to examine five-min changes in the DM rate for the January 1, 1992–December 31, 1994 period. Similarly, Andersen and Bollerslev (1998) use quotation data to examine five-min changes in the DM rate for the October 1, 1992–September 30, 1993 period. They examine the 25 largest absolute five-min price changes over this period and find that 13 of them were preceded by a macroeconomic announcement. Of the 13 announcements, six were the US employment

report. In other analyses in the paper, they find the employment report the most important of the various announcements.

Gwilym et al. (1999) examine five-min stock price changes using FTSE-100 data. The data are for the January 24, 1992–June 30, 1995 period. Clare and Courtenay (Assessing the Impact of Macroeconomics News Announcements on Securities Prices over Different Monetary Policy Regimes, unpublished, 2000) examine five-min changes using FTSE-100 data and quotation data on the dollar/pound and DM/pound exchange rates. Bollerslev et al. (2000) examine US Treasury bond futures for the January 1994–December 1997 period. Like Fleming and Remolona (1997) they find each of the 25 largest absolute five-min price changes associated with an announcement. Anderson et al. (2001) use quotation data to examine five-min price changes in six exchange rates for the January 3, 1992–December 30, 1998 period and find strong announcement effects. Finally, Cai et al. (2001) use quotation data to examine five-min price changes in the yen/dollar exchange rate in 1998. They also find strong announcement effects, with the employment report being the most important.

This study considers a longer period (1982–2000) than has been used before, and it considers stock prices, bond prices, and exchange rates at the same time. In addition, newswires are used to search for events other than macroeconomic announcements that caused large price changes. Of the 221 events found, 70 are not US macroeconomic announcements. Finally, tick data, which are actual transactions data, have been used exclusively. As noted above, some of the exchange rate data that have been used in previous studies are quotation data, not transactions data.

2. The data

The symbols used for the futures contracts are: *SP* for the S&P 500, *US* for the 30 year US Treasury bond, *DM* for the deutsche mark, *JY* for the yen, *BP* for the British pound, and *EC* for the euro. All but the *US* contract are traded on the Chicago Mercantile Exchange (CME). The *US* contract is traded on the Chicago Board of Trade (CBT). The first date used in this study is April 2, 1982, the first day that *SP* and *US* data are available. (The *BP* and *DM* data go back to 1974, and the *JY* data go back to 1977.) The last date used for all the contracts is March 31, 2000. The *DM* data were replaced by the *EC* data beginning June 1, 1999, although both contracts traded somewhat before and after this date.

The regular trading hours for the *SP* contract are 9:30–16:15 Eastern time (10:00–16:15 prior to September 30, 1985)¹. The regular trading hours for the other contracts are 8:20–15:00. Many US government data announcements occur at 8:30, which means that the prices of all the contracts except the *SP* contract can respond to them at the time of the announcement. In 1994 the 'GLOBEX' market began on the CME, where contracts are traded after regular trading hours. The GLOBEX market roughly

¹ All times in this paper are Eastern even though the CME and CBT are in the Central time zone.

covers all the remaining hours in the week except from Friday at 16:16 through Sunday at 18:29. All the above contracts are traded on the GLOBEX market except the *US* contract. The main advantage of the GLOBEX market from the perspective of this study is that the *SP* contract is trading at the time of 8:30 announcements. GLOBEX data are missing for the last five months of 1998.

For each variable, such as *SP*, there are a number of contracts trading at the same time, each with a different terminal date. There is, however, always one most actively traded contract, and this is the one that was used².

The tick data were used to create price observations per minute. The price of the last trade in a given minute was taken to be the price for that minute. (Typically many trades take place per minute, and so there are typically many tick prices per minute.) A *k*-minute percentage price change is then simply the price for a given minute divided by the price *k* minutes ago (with 1 then subtracted and the resulting value multiplied by 100). Table 1 presents a summary of the data. For the *SP* contract, for example, there are 2,200,079 price-level observations, 1,980,091 one-min changes, and 1,942,153 five-min changes. There are fewer changes than levels because a *k*-minute change requires price levels *k* minutes apart, and such prices are not always available. (In some minutes no trades take place³.) For the *SP* contract the standard deviation is 0.048 for the one-min changes and 0.107 for the five-min changes. The standard deviations for the other contracts range from 0.032 to 0.037 for the one-min changes and from 0.064 to 0.070 for the five-min changes. The means of all the changes, which are not presented in the table, are very close to zero.

The one-through five-min percentage price changes were then searched for large and rapid changes. Any change was considered large if it was greater than 0.75

Table 1
Summary of the data^a

	<i>SP</i>	<i>US</i>	<i>DM</i>	<i>EC</i>	<i>JY</i>	<i>BP</i>
# price levels	2,200,079	1,474,055	1,455,219	97,621	1,610,040	1,214,151
# one-minute changes	1,980,091	1,350,952	1,160,009	53,579	1,241,717	867,750
# five-minute changes	1,942,153	1,325,089	1,132,719	50,787	1,205,830	835,171
SD of one-minute changes	0.048	0.037	0.034	0.035	0.032	0.034
SD of five-minute changes	0.107	0.070	0.064	0.065	0.066	0.069

^a Period: April 2, 1982–March 31, 2000. Price level: last tick price of the minute. *SP*=S&P 500. *US*=30 year US Treasury bond. *DM*=deutsche mark. *EC*=euro. *JY*=yen. *BP*=British pound

² The tick data were purchased from the Futures Industry Institute and Tick Data Inc. Tick data were also purchased for the Nikkei 225 futures contract and the T-Bill futures contract, both traded on the CME. The trading in these contracts, however, was too thin for the data to be useful. The Nikkei 225 data began September 25, 1990, and there were 169,044 price-level observations. The T-Bill data began January 4, 1982, and there were 270,700 price-level observations.

³ Table 1 shows, for example, that for *SP* there are 1,980,091 one-min price changes out of 2,200,079 price levels, a decrease of 10.0%. For the five-min price changes there is a decrease of 11.7%.

percentage points in absolute value. Given that the above standard deviations range from 0.032 to 0.107, a change of 0.75 in absolute value is unusual, i.e., very large. Each minute was flagged if it ended a large one- or two- or three- or four or five-min change. Some minutes were, of course, flagged more than once. Counting multiple flagging as only one flag, there were 2220 flagged minutes for *SP*, 371 for *US*, 293 for *DM*, 17 for *EC*, 427 for *JY*, and 187 for *BP*. The same minute was sometimes flagged for more than one contract. The flagged minutes were then searched in the manner discussed next.

3. Searching for events

For each flagged minute a search was undertaken to see if some announcement or other event occurred within about five min of the flagged minute. (Remember that a change for a flagged minute can be anywhere from a one- to a five-min change, where the flagged minute is at the *end* of the change.) The Dow Jones Interactive service on the internet was used for this purpose. This service allows one to search for news reports by time of day. The following four news services were searched: *Dow Jones News Service*, *Associated Press Newswire*, *New York Times*, and *Wall Street Journal*.

As noted in Section 1, 69 events were found in Fair (2002) for the *SP* contract. The additional searching came up with 152 more events, for a total of 221. These events are listed in Table 2, and the rest of this section is a discussion of this table.

As can be seen in Table 2, many of the events are 8:30 government announcements. One of these announcements is the monthly employment report, which, as discussed in Section 1, has been found to be important in a number of studies. The employment report contains data from both the household survey and the establishment survey. The main variable of interest from the household survey is the unemployment rate, and the main two variables of interest from the establishment survey are the number of jobs (called ‘payrolls’) and average hourly earnings. The variable that gets the most attention is the payroll variable, with the average hourly earnings variable second. The payroll value is listed in Table 2 along with the average hourly earnings value (called ‘wage’ in the table) when it was available from the press reports. The ‘event’ for this announcement is, of course, the entire employment report.

The other monthly 8:30 announcements are those for 1) the consumer price index (CPI), 2) the producer price index (PPI), 3) the US balance of trade (the ‘trade gap’), 4) retail sales, 5) orders for durable goods, and 6) housing starts. The two quarterly 8:30 announcements are for the employment cost index (ECI), a measure of wage costs, and the national income and product accounts. The two variables listed in the table from the national income and product accounts are real GDP and the GDP deflator. In the early part of the period the retail sales announcement was at 14:30.

Another announcement is for industrial production. In the early part of the period it was at 9:30, and it is now at 9:15. In the early part of the period the money supply (M1) announcement was important, and it was at 16:10. An important non

Table 2
The events in chronological order^{ab}

#	Day	Base	SP	US	DM	JY	BP	a	b	Event
		minute								
1	6/25/82	16:09	1.05					sp	R	16:10: M1 down \$2.3 billion.
2	7/9/82	16:09	0.71					sp	R	16:10: M1 down \$3.7 billion.
3	7/13/82	12:18	0.67		0.05	0.08	0.09	sp	C	12:20: IBM profits \$1.68 vs \$1.37 year ago.
4	7/16/82	16:09	-0.78					sp	R	16:10: M1 up \$5.9 billion.
5	8/11/82	14:30	0.19					sp	Y	14:30: Retail sales up 1.0%.
6	8/13/82	16:09	0.67					sp	R	16:10: M1 up \$2.0 billion.
7	8/19/82	14:02	-0.55		0.05	0.05	0.00	sp	X	?time: Rumor major US bank in trouble over Mexican loans.
8	8/24/82	13:38	-0.35		-0.07	0.03	-0.08	sp	C	13:40: GM mid August sales down to 81,597 from 134,949.
9	9/14/82	15:29	-0.88					sp	F	15:27: Rostenkowski said tax boost needed for defense.
10	9/23/82	11:08	-0.57		0.00	0.00	0.00	sp	R	?time: Five Fed Presidents testified before Congress.
11	10/1/82	16:09	-0.99					sp	R	16:10: M1 up \$0.4 billion.
12	10/8/82	16:09	0.19					sp	R	16:10: M1 down \$2.7 billion.
13	10/22/82	16:09	-1.07					sp	R	16:10: M1 up \$3.2 billion.
14	11/5/82	16:09	-1.04					sp	R	16:10: M1 up \$2.7 billion.
15	11/16/82	15:11	0.91					sp	R	?time: Rumor Larry Speakes said Fed will lower discount rate.
16	12/2/82	14:34	-0.72					sp	Y	14:30: New home sales down 0.4%.
17	12/9/82	15:21	-0.92					sp	F	?time: Howard Baker withdrew capital gains bill.
18	12/5/82	10:55	-0.73		-0.02	-0.07	0.00	sp	F	10:56: Murray Weldbaum testified deficit hurts recovery.
19	10/25/84	10:15	-0.03	-0.13	0.87	0.41	0.45	DM	I	10:21: Bundesbank intervened.
20	2/26/85	11:20	0.17	0.04	1.07	0.13	0.48	DM	X	?time: Volcker testified maybe more FX intervention needed.
21	9/13/85	9:29		0.76	0.26	0.07	0.26	US	Y	9:30: Industrial production up 0.3%.
22	1/17/86	9:54	-0.55	-0.07	-0.02	0.00		sp	C	9:54: IBM profits \$4.36 vs \$3.55 year ago.

(continued on next page)

Table 2 (continued)

#	Day	Five-minute change (percentage points)	US	DM	JY	BP	a	b	Event
	Base	SP							
	minute								
23	2/7/86	8:29		-0.41	-0.29	-0.48	DM	Y	8:30: Payrolls up 566,000; wage up 0.2%.
24	2/7/86	11:59	-0.98	-0.41	-0.13	-0.07	sp	F	12:00:
25	2/19/86	11:37	-0.04	-0.73	-0.64	-0.50	JY	X	3 judge panel ruled Gramm-Rudman unconstitutional. ?time: Volcker testimony.
26	2/19/86	12:36	0.02	-0.48	-0.48	-0.44	DM	X	?time: Volcker voiced worry over value of dollar.
27	2/27/86	10:54	0.07	-0.55	-0.65	-0.24	DM	X	?time: Preston Martin denied rumor about G5 meeting.
28	3/6/86	9:44	-0.11	0.07	0.31	0.03	US	J	9:43: Source said BOJ reducing discount rate by 50bp.
29	3/7/86	9:08	-1.30	-0.67	-0.29	-0.99	US	R	9:06: Fed cut discount rate by 50bp to 7.0.
30	4/17/86	8:29		-0.49	-0.51	-0.25	DM	Y	8:30: GDP up 3.2%; deflator up 2.5%.
31	6/13/86	9:14	0.96	0.20	0.21	0.03	US	Y	9:15: Industrial production down 0.6%.
32	9/12/86	8:29		0.83	0.25	0.31	DM	P	8:30: PPI up 0.3%. Retail sales up 0.8%.
33	10/31/86	8:29	-0.49	-0.49	-0.16	-0.14	DM	X	?time: James Baker hailed Japanese rate cut
34	12/31/86	8:29		0.50	0.38	0.31	DM	T	8:30: Trade gap widened to \$19.22 billion.
35	1/30/87	8:29		-1.36	-0.67	-0.25	DM	T	8:30: Trade gap narrowed to \$10.66 billion.
36	7/15/87	8:29		0.52	0.63	0.32	JY	T	8:30: Trade gap widened to \$14.40 billion.
37	8/14/87	8:29		1.17	1.49	0.60	DM	T	8:30: Trade gap widened to \$15.71 billion.
39	9/11/87	8:29		1.06	1.02	0.75	DM	T	8:30: Trade gap widened to \$16.47 billion.
39	10/14/87	8:29		0.51	0.67	0.32	DM	T	8:30: Trade gap narrowed to \$15.68 billion.
40	11/10/87	10:45	0.48	-0.36	-0.23	-0.29	DM	X	?time: Reagan said he wanted no further dollar decline.
41	11/12/87	8:29		-0.74	-0.54	-0.40	DM	T	8:30: Trade gap narrowed to \$14.05 billion.
42	12/10/87	8:29		2.37	1.27	2.37	DM	T	8:30: Trade gap widened to \$17.63 billion.
43	1/15/88	8:29		-2.50	-3.16	-1.95	DM	T	8:30: Trade gap narrowed to \$13.22 billion.
44	2/12/88	8:29		-1.00	-1.78	-1.05	DM	T	8:30: Trade gap narrowed to \$12.20 billion.
45	3/17/88	9:29		-0.20	-0.66	-0.17	JY	T	8:30: Trade gap widened to \$12.44 billion.

Table 2 (continued)

#	Day	Base minute	SP	US	DM	JY	BP	a	b	Event
46	4/14/88	8:29			1.58	1.59	1.30	DM	T	8:30: Trade gap widened to \$13.83 billion.
47	5/17/88	8:29			-1.11	-1.12	-1.15	DM	T	8:30: Trade gap narrowed to \$9.75 billion.
48	6/14/88	8:29			-0.62	-0.19	-0.75	DM	T	8:30: Trade gap narrowed to \$9.89 billion.
49	8/16/88	8:29			1.60	0.26	0.35	DM	T	8:30: Trade gap widened to \$12.54 billion.
50	9/14/88	8:29			-0.79	-0.85	-0.60	DM	T	8:30: Trade gap narrowed to \$9.53 billion.
51	10/13/88	8:29			0.84	0.89	0.64	DM	T	8:30: Trade gap widened to \$12.18 billion.
52	11/4/88	8:29			-0.80	-0.58	-0.42	DM	Y	8:30: Payrolls up 323,000; wage up 0.7%.
53	12/2/88	8:29	-1.09		-0.73	-0.41	-0.31	US	Y	8:30: Payrolls up 463,000; wage down 0.1%.
54	1/18/89	9:29	-0.28		0.46	0.51	0.63	BP	T	8:30: Trade gap widened to \$12.51 billion.
55	2/3/89	8:29	-0.49		-0.09	-0.24	-0.21	US	Y	8:30: Payrolls up 408,000; wage up 0.6%.
56	2/10/89	8:29	-0.70		-0.02	0.03	-0.02	US	P	8:30: PPI up 1.0%; core up 0.4%.
57	3/17/89	8:29	-1.17		-0.17	-0.23	-0.22	US	P	8:30: PPI up 1.0%; core up 0.6%.
58	5/5/89	8:29	0.77		0.40	0.23	0.36	US	Y	8:30: Payrolls up 117,000; wage up 0.7%.
59	5/12/89	8:29	1.54		0.08	0.09	0.11	US	P	8:30: PPI up 0.4%; core down 0.1%.
60	5/17/89	9:29	-0.07		-0.85	-0.75	-0.94	DM	T	8:30: Trade gap narrowed to \$8.86 billion.
61	6/9/89	8:29	-1.30		-0.40	-0.56	-0.42	US	P	8:30: PPI up 0.9%; core up 0.5%.
62	6/15/89	8:29	0.10		-0.71	-0.48	-0.34	DM	T	8:30: Trade gap narrowed to \$8.26 billion.
63	8/4/89	8:29	-0.69		-0.77	-0.77	-0.67	US	Y	8:30: Payrolls up 169,000; wage up 0.8%.
64	8/11/89	8:29	0.86		0.31	0.31	0.30	US	P	8:30: PPI down 0.4%; wage down 0.2%; retail sales up 0.9%.
65	8/17/89	8:29	0.29		-0.68	-0.43	-0.77	BP	T	8:30: Trade gap narrowed to \$8.17 billion.
66	9/15/89	8:29	0.29		-1.00	-0.66	-0.94	DM	T	8:30: Trade gap narrowed to \$7.58 billion.
67	10/5/89	9:00	-0.10		0.49	0.31	0.68	BP	G	9:02: Bundesbank raised rate by 100bp.
68	10/6/89	8:29	0.42		0.61	0.51	0.32	US	Y	8:30: Payrolls up 209,000; wage up 0.5%.
69	10/13/89	8:29	-0.29		-0.66	-0.07	-0.21	DM	P	8:30: PPI up 0.9%; core up 0.7%.
70	10/7/89	8:29	0.00		0.56	0.55	0.58	DM	T	8:30: Trade gap widened to \$10.77 billion.
71	5/4/90	8:29	0.66		0.37	0.29	0.56	US	Y	9:30: Payrolls up 64,000; wage up 0.3%.

Table 2 (continued)

#	Day	Base minute	US SP	DM	JY	BP	a	b	Event
72	5/11/90	8:29	0.86	0.52	0.28	0.35	US	P	9:30: PPI down 0.3%; core up 0.2%; retail sales down 0.6%.
73	6/1/90	8:29	0.91	0.49	0.33	0.38	US	Y	8:30: Payrolls up 164,000 (all gov.); wage up 0.4%.
74	8/3/90	9:46	-0.72	0.13	0.13	0.09	sp	W	?time: Iraq invaded Kuwait.
75	8/17/90	12:13	-0.46	0.06	0.07	-0.01	sp	W	12:11: Pentagon recommended maybe calling up reserves.
76	8/21/90	11:13	0.98	-0.03	-0.10	-0.02	sp	W	11:13: Iraq's Aziz said he is ready to discuss Gulf situation.
77	10/5/90	11:03	0.32	-0.69	-0.04	0.46	DM	X	11:09: UK cut rate by 100bp; pound to enter ERM.
78	10/9/90	15:41	-0.81				sp	X	15:39: Brazil's central bank pres. said rescheduling needed.
79	10/12/90	11:53	0.50	0.06	0.05	0.02	sp	W	11:51: Exile party said Iraq considering withdrawal.
80	12/4/90	15:32	0.99				sp	W	?time: British TV reported Iraq made new offer on Kuwait.
81	1/4/91	8:29	-0.80	-0.46	-0.45	-0.31	US	Y	8:30: Payrolls down 76,000; wage up 0.6%.
82	2/1/91	8:29	0.91	0.40	0.45	0.43	US	Y	8:30: Payrolls down 232,000; wage down 0.1%.
83	3/19/91	8:29	-0.76	-0.51	-0.22	-0.43	US	P	8:30: CPI up 0.2%; core up 0.7%.
84	4/5/91	9:32	0.01	-0.74	-0.49	-0.54	DM	X	9:32: Bundesbank said dollar rise not from fundamentals.
85	4/30/91	9:30	0.65	0.47	0.14	0.41	sp	R	9:30: Fed cut funds rate by 25bp to 5.75.
86	5/3/91	8:29	-0.39	-1.12	-0.54	-0.89	US	Y	8:30: Payrolls down 124,000; wage up 0.5%.
87	7/12/91	9:15	0.00	0.93	0.21	0.62	DM	G	9:14: Germany to take phased approach to inflation.
88	8/2/91	8:29	0.76	0.76	0.50	0.96	US	Y	8:30: Payrolls down 51,000; wage down 0.1%.
89	8/23/91	8:29	-0.67	-0.78	-0.21	-0.62	DM	Y	8:30: Durable goods up 10.7%.
90	9/13/91	9:09	-0.28	-0.68	-0.47	-0.66	DM	R	9:09: Fed cut discount rate 50bp to 5.0.
91	11/1/91	8:29	0.75	0.12	0.47	0.28	US	Y	8:30: Payrolls down 1000; wage down 0.1%.

Table 2 (continued)

#	Day	Five-minute change (percentage points)		US	DM	JY	BP	a	b	Event
		Base	SP							
		minute								
92	11/13/91	8:29		-0.93	-0.34	-0.17	-0.28	US	P	8:30: PPI up 0.7%; core up 0.5%.
93	11/14/91	8:29		0.50	0.15	0.09	0.20	US	P	8:30: CPI up 0.1%; core up 0.1%; retail sales down 0.1%.
94	1/10/92	8:29		-0.12	-0.91	-0.29	-1.24	DM	Y	8:30: Payrolls up 31,000 (-74,000 expected); wage up 0.7%
95	1/17/92	13:28	-0.08	0.00	0.36	0.85	0.31	JY	X	13:32: Schlesinger said monetary stability in peril.
96	2/13/92	8:29		-0.40	-0.93	-0.29	-0.65	DM	Y	8:30: Retail sales up 0.6%.
97	7/2/92	8:29		1.24	0.88	0.39	0.54	US	Y	8:30: Payrolls down 117,000; wage up 0.2%.
98	7/2/92	10:17	-1.06	-0.12	-0.03	-0.09	-0.09	sp	R	10:18: Sen. Riegle said Fed 50bp cut an emergency response.
99	7/20/92	10:15	0.19	-0.03	-0.51	-0.31	-0.32	DM	I	?time: Coordinated intervention.
100	8/21/92	9:19		-0.03	-0.78	-0.24	-0.46	DM	I	?time: Fed intervention.
101	9/4/92	8:29		0.98	1.14	0.53	0.68	US	Y	8:30: Payrolls down 83,000; wage up 0.7%.
102	9/16/92	14:46	-0.08	-0.21	0.85	0.41	1.69	DM	X	14:43: Bank of England to suspend pound from ERM.
103	10/2/92	8:29		-0.35	-1.13	-0.53	-0.87	DM	Y	8:30: Payrolls down 57,000; wage down 0.2%.
104	11/19/92	8:29		0.15	-0.62	-0.12	-0.47	DM	Y	8:30: Housing starts down 1.1%.
105	3/5/93	8:29		-0.75	-0.53	-0.38	-0.45	US	Y	8:30: Payrolls up 365,000.
106	4/22/93	9:15		-0.08	-0.08	0.02	-0.01	DM	G	9:16: Bundesbank cut Lombard rate and discount rate.
107	6/4/93	8:29		-0.54	-0.99	-0.33	-0.72	DM	Y	8:30: Payrolls up 209,000; wage up 0.6%.
108	6/11/93	8:29		0.48	0.79	0.24	0.59	DM	P	8:30: PPI unchanged; core up 0.2%. Retail sales up 0.1%.
109	7/2/93	8:29		0.44	0.43	0.46	0.50	DM	Y	8:30: Payrolls up 13,000; wage down 0.1%.
110	7/16/93	8:29		0.05	-0.19	-0.78	-0.27	JY	T	8:30: Trade gap narrowed to \$8.37 billion.
111	9/3/93	8:29		0.37	0.76	0.42	0.67	DM	Y	8:30: Payrolls down 39,000; wage up 0.5%.
112	9/10/93	8:29		0.47	0.02	-0.23	-0.01	US	P	8:30: PPI down 0.6%; core down 1.0%.

Table 2 (continued)

#	Day	Base minute	SP	US	DM	JY	BP	a	b	Event
113	9/21/93	12:16	-0.01	0.03	-0.72	-0.12	-0.79	DM	W	12:16: Yeltsin suspended parliament.
114	10/8/93	8:29	-0.05	-0.05	0.46	0.10	0.35	DM	Y	8:30: Payrolls up 156,000; wage unchanged.
115	11/9/93	8:29	0.56	0.36	0.36	0.13	0.34	US	P	8:30: PPI down 0.2%; core down 0.5%.
116	1/7/94	8:29	0.10	0.90	0.07	0.10	0.01	US	Y	8:30: Payrolls up 183,000; wage up 0.2%.
117	2/4/94	8:29	0.15	0.48	0.40	0.24	0.44	US	Y	8:30: Payrolls up 62,000; wage up 0.7%.
118	4/1/94	8:29	-0.24	-0.57	-0.57	-0.24	-0.29	US	Y	8:30: Payrolls up 456,000; wage up 0.1%.
119	5/6/94	8:29	0.43	1.05	-0.18	-0.12	-0.03	US	Y	8:30: Payrolls up 267,000; wage up 0.3%.
120	5/12/94	8:29	0.43	1.05	0.25	0.04	0.15	US	P	8:30: PPI down 0.1%; core up 0.1%; retail sales down 0.8%.
121	7/8/94	8:29	-0.30	-0.55	-0.11	-0.06	-0.10	US	Y	8:30: Payrolls up 379,000; wage down 0.1%.
122	7/29/94	8:29	0.31	0.70	-0.11	-0.10	-0.07	US	Y	8:30: GDP up 3.7%; deflator up 2.9%.
123	8/5/94	8:29	-0.35	-1.16	-0.40	-0.14	-0.16	US	Y	8:30: Payrolls up 259,000; wage up 0.4%.
124	9/9/94	8:29	-0.38	-0.74	0.48	0.16	0.26	US	P	8:30: PPI up 0.6%; core up 0.4%.
125	10/13/94	8:29	0.96	0.79	-0.40	-0.29	-0.28	sp	P	8:30: PPI down 0.5%; core up 0.1%.
126	11/2/94	11:00	0.12	0.13	-0.66	-0.69	-0.48	DM	I	?time: US intervention.
127	11/15/94	14:36	-0.29	-0.13	0.26	0.16	0.16	sp	R	14:37: Fed raised funds rate by 75bp to 4.75.
128	2/3/95	8:29	0.22	0.62	0.08	0.09	0.11	US	Y	8:30: Payrolls up 134,000; wage up 0.6%.
129	3/10/95	8:29	-0.24	-0.61	0.28	0.44	0.10	DM	Y	8:30: Payrolls up 318,000; wage unchanged.
130	3/31/95	8:29	-0.02	-0.21	-0.03	0.00	0.02	JY	Y	8:30: GDP revised up to 5.1% from 4.7%.
131	4/26/95	10:12	0.06	0.06	-0.22	-0.54	-0.19	JY	X	?time: G10 concerned over recent FX moves.
132	5/31/95	8:35	-0.03	0.08	-0.86	-1.16	-0.47	DM	I	?time: US intervention
133	6/2/95	8:29	-0.03	1.21	0.96	0.72	0.39	US	Y	8:30: Payrolls down 101,000; wage down 0.3%.
134	7/7/95	8:29	-0.20	-0.75	-0.25	-0.21	-0.19	US	Y	8:30: Payrolls up 215,100; wage up 0.4%.
135	8/17/95	14:42	0.03	-0.03	0.43	0.84	0.34	JY	W	?time: Iraq warned US military steps will backfire.
136	9/1/95	8:29	-0.12	-0.53	-0.10	-0.22	-0.14	US	Y	8:30: Payrolls up 249,000; wage down 0.2%.
137	10/18/95	8:29	0.07	0.03	-0.89	-0.55	-0.35	DM	T	8:30: Trade gap narrowed to \$8.80 billion.
138	3/8/96	8:29	-1.54	-1.39	-0.25	-0.19	-0.19	sp	Y	Payrolls up 705,000 (most in 12 years); wage down 0.1%.

Table 2 (continued)

#	Day	Base minute	SP	US	DM	JY	BP	a	b	Event
139	4/5/96	8:29		-0.70	-0.28	-0.09	-0.21	US	Y	8:30: Payrolls up 140,000; wage up 0.3%.
140	5/2/96	8:29	-0.35	-0.74	0.00	0.01	0.04	US	Y	8:30: GDP up 2.8%; deflator up 2.1%.
141	5/3/96	8:29	0.53	0.29	0.14	0.10	-0.01	sp	Y	8:30: Payrolls up 2,000; wage up 0.6%.
142	5/10/96	8:29	0.46	0.52	-0.03	-0.02	-0.04	US	P	8:30: PPI up 0.4%; core up 0.1%.
143	6/7/96	8:29	-1.86	-2.15	0.15	0.12	0.10	sp	Y	8:30: Payrolls up 348,000; wage up 0.3%.
144	7/5/96	8:29	-0.93	-1.54	-0.15	-0.10	-0.10	US	Y	8:30: Payrolls up 239,000; wage up 0.8%.
145	8/1/96	10:00	0.72	1.03	0.04	0.04	0.05	US	Y	10:00: NAPM down.
146	8/2/96	8:29	1.38	0.93	0.12	-0.05	0.01	sp	Y	8:30: Payrolls up 193,000; wage down 0.2%.
147	9/6/96	8:29	-0.25	-0.41	-0.13	-0.08	-0.06	sp	Y	8:30: Payrolls up 250,000; wage up 0.5%.
148	9/13/96	8:29	0.84	0.87	0.15	0.05	0.09	sp	P	8:30: CPI up 0.1%; core up 0.1%.
149	10/4/96	8:29	0.31	0.39	-0.08	-0.04	-0.06	US	Y	8:30: Payrolls down 40,000; wage up 0.5%.
150	1/10/97	8:29	-0.61	-0.90	0.13	0.14	-0.07	US	Y	8:30: Payrolls up 262,000; wage up 0.5%.
151	1/28/97	8:29	0.58	0.60	-0.10	-0.04	-0.01	US	Z	8:30:ECI up 0.8%.
152	1/29/97	8:29	0.59	0.34	-0.11	-0.13	-0.05	sp	Y	8:30: Durable goods down 1.7%.
153	2/26/97	9:59	-1.11	-0.64	0.10	0.12	-0.01	sp	R	10:00: Greenspan testimony: angst about stock market.
154	3/7/97	8:29	-0.24	-0.34	0.05	-0.01	-0.02	sp	Y	8:30: Payrolls up 339,000; wage up 0.2%.
155	4/15/97	8:29	0.78	0.58	0.16	0.05	0.06	sp	P	8:30: CPI up 0.1%; core up 0.2%.
156	4/29/97	8:29	1.09	1.37	0.17	0.06	0.10	sp	Z	8:30: ECI up 0.6%.
157	5/20/97	14:14	0.60	0.17	0.36	0.66	0.17	sp	R	14:15: Fed kept rates unchanged.
158	6/6/97	8:29	-0.48	-0.23	-0.24	-0.07	0.00	sp	Y	8:30: Payrolls up 138,000; wage up 0.3%.
159	6/11/97	23:36			-0.03	-1.17		JY	X	?time: Sakakibara warned about too strong a yen.
160	8/1/97	10:00	-0.63	-0.40	-0.06	0.07	0.01	sp	Y	10:00: New orders up 1.2%; strong NAPM report.
161	8/13/97	8:29	1.42	0.78	-0.26	-0.27	-0.14	sp	P	8:30: PPI down 0.1%; core down 0.1%.
162	9/2/97	10:00	0.68	0.47	-0.04	0.04	0.01	sp	Y	10:00: NAPM 56.8 vs 58.6 last month.
163	10/3/97	8:29	0.75	0.88	0.23	0.08	0.11	sp	Y	8:30: Payrolls up 215,000; wage up 0.3%.
164	10/10/97	8:29	-0.99	-0.84	-0.03	0.08	0.04	sp	P	8:30: PPI up 0.5%; core up 0.4%.
165	12/5/97	8:29	-1.12	-0.95	-0.35	-0.13	-0.10	sp	Y	8:30: Payrolls up 404,000; wage up 0.6%.

Table 2 (continued)

#	Day	Base minute	SP	US	DM	JY	BP	a	b	Event
166	1/5/98	19:50	-0.05		0.04	0.89	0.04	JY	I	?time: Japan intervened.
167	3/19/98	19:38	0.02			0.74		JY	I	?time: Japan intervened.
168	4/9/98	4:05	0.04		-0.16	-0.58		JY	J	?time: Hashimoto announced tax cuts.
169	4/30/98	8:29	1.05	0.74	-0.07	-0.04	0.06	sp	Z	8:30: ECT up 0.7%; GDP up 4.2%; deflator up 0.9%.
170	6/17/98	7:54	0.05		0.27	1.23	0.23	JY	I	?time: US and Japan intervened.
171	6/24/98	2:31	0.04		0.22	0.92		JY	I	?time: Japan intervened.
172	7/2/98	23:14				0.75		JY	J	?time: Hashimoto talked of permanent tax cuts.
173	8/11/98	20:16			0.12	0.70		JY	X	?time: Kuroda: will take necessary FX steps.
174	9/9/98	5:17			-0.09	-1.33	-0.07	JY	J	?time: BOJ cut rate to 0.25.
175	9/29/98	14:16	-1.55	0.24	-0.23	-0.46	-0.11	sp	R	14:17: Fed cut funds rate 25bp to 5.25.
176	10/13/98	3:09			0.30	0.83		JY	J	?time: BOJ kept policy unchanged.
177	10/15/98	15:14	5.07					sp	R	15:14: Fed cut funds rate 25bp-not normal meeting.
178	11/12/98	11:45	0.02	-0.05	0.10	0.23	0.04	JY	J	?time: Japan stimulus package announced.
179	11/16/98	20:58			-0.03	-0.22		JY	X	21:01: Moody's cuts Japan's FX rating to A.A1.
180	11/17/98	14:18	0.97	0.10	0.12	0.12	0.04	sp	R	14:15: Fed cut funds rate 25bp.
181	11/19/98	21:37			-0.10	-1.03		JY	J	?time: Miyazawa: no sales tax cut for now, debate possible.
182	1/7/99	5:22	0.00		-0.08	-0.86	0.02	JY	J	?time: Japan's consumer spending up; recovery seems distant
183	1/11/99	20:05	0.05			-0.91		JY	X	?time: Miyazawa: no comment on whether will intervene.
184	1/12/99	2:12	0.04			-0.86		JY	X	?time: Nonaka: excessive yen rise not good.
185	1/15/99	8:07	0.81					sp	X	8:10: Estado said Brazil won't intervene in FX market.
186	2/23/99	9:59	-0.82	-0.08	0.09	0.12	0.05	sp	R	10:00: Greenspan testimony: economy maybe stretched.
187	3/5/99	8:29	0.73	1.04	0.29	0.22	0.10	sp	Y	8:30: Payrolls up 275,000; wage up 0.1%.
188	3/11/99	11:44	-0.05	0.08	0.61	0.44	0.16	DM	G	?time: Lafontaine resigned.

Table 2 (continued)

#	Day	Base minute	SP	US	DM	JY	BP	a	b	Event
189	5/7/99	8:29	0.45	0.53	-0.20	-0.16	-0.11	US	Y	8:30: Payrolls up 234,000; wage up 0.2%.
190	5/12/99	9:45	-1.29	-0.11	0.35	0.75	0.16	sp	F	?time: Rubin to announce resignation; Summers is successor.
191	5/14/99	8:29	-0.52	-0.91	0.00	0.02	0.02	US	P	8:30: CPI up 0.7%; core up 0.4%.
192	5/18/99	14:10	-0.65	-0.37	-0.11	-0.15	0.02	sp	R	14:11: Fed let rates stand; adopted tightening bias.
193	6/1/99	10:00	-0.85	-0.37	0.10	0.19	0.05	sp	Y	10:00: NAPM 55.2 vs. 52.8 last month.
194	6/4/99	8:29	-0.22	-0.19	0.00	-0.17	-0.04	sp	Y	8:30: Payrolls up 11,000; wage up 0.4%.
195	6/13/99	20:10			-0.06	-0.56	-0.16	JY	I	?time: Japan intervened.
196	6/16/99	8:29	0.44	0.19	-0.06	-0.08	0.11	sp	P	8:30: CPI unchanged; core up 0.1%.
197	6/30/99	14:15	1.33	0.62	0.27	0.01	0.06	sp	R	14:15: Fed raised funds rate 25 bp; adapted neutral bias.
198	7/20/99	9:07	0.04	-0.05	-0.29	-0.87	-0.09	JY	I	?time: US intervened.
199	8/6/99	8:29	-0.57	-0.38	0.08	0.10	0.02	sp	Y	8:30: Payrolls up 310,000; wage up .5%.
200	8/13/99	8:57	0.11	0.00	-0.52	-0.98	-0.26	JY	J	?time: Ozawa's Liberal party to stay in ruling block.
201	8/24/99	20:12	-0.01			-0.61		JY	X	?time:
202	9/3/99	8:29	1.09	0.77	-0.36	-0.16	-0.15	sp	Y	Mitoguchi: will watch FX market after Fed meeting.
203	9/8/99	19:49	-0.08			1.02		JY	J	8:30: Payrolls up 124,000; wage up 0.2%.
204	9/10/99	8:29	0.40	-0.05	-0.10	-0.11	-0.06	sp	P	?time: Japanese GDP 0.9%; deflator -0.7%.
205	9/15/99	8:29	0.83	0.41	-0.42	0.22	-0.17	sp	P	8:30: PPI up 0.5%; core down 0.1%.
206	9/21/99	3:54	-0.31			1.80		JY	J	8:30: CPI up 0.3%; core up 0.1%.
207	10/5/99	14:11	-0.72	-0.28	0.25	0.05	0.08	sp	R	?time: BOJ policy unchanged.
208	10/8/99	8:29	0.56	0.14	-0.05	0.04	-0.07	sp	Y	14:12: Fed let rates stand; adopted tightening bias.
210	10/13/99	5:15	0.00			-0.90		JY	J	8:30: Payrolls down 8,000; wage up 0.5%.
211	10/15/99	8:29	-1.03	-0.48	0.27	0.23	0.18	sp	P	?time: BOJ policy eased.
211	10/27/99	3:13	0.02			-0.54		JY	J	8:30: PPI up 1.1%; core up 0.8%.
212	11/5/99	8:29	0.95	0.38	-0.30	-0.16	-0.18	SP	Y	?time: Sony's profits down 24.5%.
										8:30: Payrolls up 310,000; wage up 0.1%.

Table 2 (continued)

#	Day	Five-minute change (percentage points)	Base	SP	US	DM	JY	BP	a	b	Event
			minute								
213	11/30/99	1:20					-0.56		JY	I	?time: Japan intervention rumored.
214	12/3/99	8:29	0.64	0.34	-0.05	0.04	0.04	-0.04	SP	Y	8:30: Payrolls up 234,000; wage up 0.1%.
215	12/14/99	8:29	-0.80	-0.33	0.00	-0.04	0.04	0.04	SP	P	8:30: CPI up 0.1%; core up 0.2%.
216	12/21/99	14:11	0.73	-0.17	-0.10	-0.05	-0.06	-0.06	SP	R	14:13: Fed let rates stand; maintained neutral bias.
217	1/6/00	16:04	-0.85		0.10	0.03			SP	C	?time: Lucent's earnings below expectations.
218	1/7/00	8:29	-0.13		-0.08	-0.05			SP	Y	8:30: Payrolls up 315,000; wage up 0.4%.
219	1/28/00	8:29	-1.41		0.24	0.29			SP	Z	8:30: ECI up 1.1%; GDP up 5.8%; deflator up 2.0%.
220	2/4/00	8:29	0.68		-0.20	0.03			SP	Y	8:30: Payrolls up 387,000; wage up 0.4%.
221	3/3/00	8:29	0.80		0.08	-0.10			SP	Y	8:30: Payrolls up 43,000; wage up 0.3%.

^a a=contract being used when the event was found. sp means the event was found in Fair (2002). b=type of event: R=monetary, P=price, Y=real, F=fiscal policy, Z=ECI, C=company, T=trade gap, X=international rumors and comments, W=international conflicts, I=foreign exchange intervention, J=Japan, G=Germany. Percentage changes are at quarterly rates for ECI, annual rates for GDP and the GDP deflator, and monthly rates for all others.

^b Abbreviations: BOJ=Bank of Japan; bp=basis points; CPI=consumer price index—core excludes food and energy; ECI=employment cost index; FX=foreign exchange; GDP=real GDP; NAPM=National Association of Purchasing Managers; PPI=producers price index—core excludes food and energy; wage=average hourly earnings from the establishment survey

government announcement is the report of the National Association of Purchasing Managers (NAPM), and this is at 10:00.

The exact times for the events that are not regularly scheduled announcements are not always clear. The exact times of the news reports are not always given, and even when they are, it may be that the report was written a few minutes after the event (rather than, say, just one min after the event). If a time was given in the report, it is indicated in Table 2; otherwise, '?time' is listed in the table. Remember, then, that when a time is given in the table for a non regularly scheduled announcement, the event may have taken place a few minutes earlier.

The order of the searching for events using the large changes was *SP*, *US*, *DM*, *EC*, *JY*, and *BP*. Table 2 indicates which contract observations were being used when the particular event was found⁴.

Many of the 8:30 announcements were not found using the *SP* contract (but instead using the *US* or *DM* contract) because the *SP* contract was not traded at 8:30 until 1994. All the trade gap announcements were found using the exchange rate contracts.

For reference purposes the 221 events were divided into 12 kinds, and each kind is denoted by a letter in Table 2. *R* denotes monetary events, primarily money supply announcements and interest rate announcements. In October 1982 the Fed announced that it was going to put less weight on monetary aggregate targets in the future, and soon after that the money supply announcements ceased being important, with interest rate announcements taking their place. The interest rate announcements are regarding the federal funds and/or discount rate. The funds rate is more important than the discount rate, and it is listed in Table 2 over the discount rate if both were mentioned in the newswires. *P* denotes price announcements, either the CPI or the PPI. *Y* denotes macro announcements about real variables, primarily payrolls, GDP, and NAPM. *Z* denotes ECI (wage) announcements. *F* denotes US fiscal policy events. *C* denotes announcement of individual company earnings. *T* denotes trade gap announcements. *X* is a catch all that denotes foreign exchange comments by various government officials and rumors. *W* denotes events related to international conflicts or potential conflicts (all Iraq except one for Russia). *I* denotes the intervention of central banks in foreign exchange markets. Interventions are usually not announced, but simply observed by market participants as they are happening. Finally, *J* denotes events that are specific to Japan, and *G* denotes events that are specific to Germany. The events are organized into these 12 categories in Table 3. This table is used in the next section.

Five-min changes are also presented in Table 2 (and Table 3) for each event. Although the searching for large changes was done using one- through five-min changes for each contract, only five-min changes are presented in the table. The five-min change is from a 'base' minute (min 0) to the minute five mins away (min 5). For each scheduled announcement, the base minute was taken to be the minute right before the announcement, such as 8:29 for a 8:30 announcement. For the other events a plot of the price level per minute for each variable was made around the approxi-

⁴ A lower case *sp* means the event was one of the 69 events found in Fair (2002).

Table 3
The events by type^a

#	Day	Five-minute change (percentage points)	Base	SP	US	DM	IY	BP	a	b	Event
			minute								
Monetary events											
1	6/25/82	16:09	1:05						sp	R	16:10: M1 down \$2.3 billion.
2	7/9/82	16:09	0.71						sp	R	16:10: M1 down \$3.7 billion.
4	7/16/82	16:09	-0.78						sp	R	16:10: M1 up \$5.9 billion.
6	8/13/82	16:09	0.67						sp	R	16:10: M1 up \$2.0 billion.
10	9/23/82	11:08	-0.57		0.00		0.00		sp	R	?time: Five Fed Presidents testified before Congress.
11	10/1/82	16:09	-0.99						sp	R	16:10: M1 up \$0.4 billion.
12	10/8/82	16:09	0.19						sp	R	16:10: M1 down \$2.7 billion.
13	10/22/82	16:09	-1.07						sp	R	16:10: M1 up \$3.2 billion.
14	11/5/82	16:09	-1.04						sp	R	16:10: M1 up \$2.7 billion.
15	11/16/82	15:11	0.91						sp	R	?time:
29	3/7/86	9:08		-1.30	-0.67	-0.29	-0.99		US	R	Rumor Larry Speakes said Fed will lower discount rate.
85	4/30/91	9:30	0.65	0.20	0.47	0.14	0.41		sp	R	9:06: Fed cut discount rate by 50bp to 7.0.
90	9/13/91	9:09		-0.28	-0.68	-0.47	-0.66		DM	R	9:30: Fed cut funds rate by 25bp to 5.75.
98	7/2/92	10:17	-1.06	-0.12	-0.03	-0.09	-0.09		sp	R	9:09: Fed cut discount rate 50bp to 5.0.
127	11/15/94	14:36	-0.29	-0.13	0.26	0.16	0.16		sp	R	10:18: Sen. Riegle said Fed 50bp cut an emergency response.
153	2/26/97	9:59	-1.11	-0.64	0.10	0.12	-0.01		sp	R	14:37: Fed raised funds rate by 75bp to 4.75.
157	5/20/97	14:14	0.60	0.17	0.36	0.66	0.17		sp	R	10:00: Greenspan testimony: angst about stock market.
175	9/29/98	14:16	-1.55	0.24	-0.23	-0.46	-0.11		sp	R	14:15: Fed kept rates unchanged.
177	10/15/98	15:14	5.07						sp	R	14:17: Fed cut funds rate 25bp to 5.25.
180	11/17/98	14:18	0.97	0.10	0.12	0.12	0.04		sp	R	15:14: Fed cut funds rate 25bp-not normal meeting. 14:15: Fed cut funds rate 25bp.

(continued on next page)

Table 3 (continued)

#	Day	Base minute	SP	US	DM	IY	BP	a	b	Event
186	2/23/99	9:59	-0.82	-0.08	0.09	0.12	0.05	sp	R	10:00: Greenspan testimony; economy may be stretched.
192	5/18/99	14:10	-0.65	-0.37	-0.11	-0.15	0.02	sp	R	14:11: Fed let rates stand; adopted tightening bias.
197	6/30/99	14:15	1.33	0.62	0.27	0.01	0.06	sp	R	14:15: Fed raised funds rate 25 bp; adapted neutral bias.
207	10/5/99	14:11	-0.72	-0.28	0.25	0.05	0.08	sp	R	14:12: Fed let rates stand; adopted tightening bias.
216	12/21/99	14:11	0.73	-0.17	-0.10	-0.05	-0.06	SP	R	14:13: Fed let rates stand; maintained neutral bias.
Price Events										
32	9/12/86	8:29			0.83	0.25	0.31	DM	P	8:30: PPI up 0.3%; Retail sales up 0.8%.
56	2/10/89	8:29		-0.70	-0.02	0.03	-0.02	US	P	8:30: PPI up 1.0%; core up 0.4%.
57	3/17/89	8:29		-1.17	-0.17	-0.23	-0.22	US	P	8:30: PPI up 1.0%; core up 0.6%.
59	5/12/89	8:29		1.54	0.08	0.09	0.11	US	P	8:30: PPI up 0.4%; core down 0.1%.
61	6/9/89	8:29		-1.30	-0.40	-0.56	-0.42	US	P	8:30: PPI up 0.9%; core up 0.5%.
64	8/11/89	8:29		0.86	0.31	0.31	0.30	US	P	8:30: PPI down 0.4%; wage down 0.2%; retail sales up 0.9%.
69	10/13/89	8:29		-0.29	-0.66	-0.07	-0.21	DM	P	8:30: PPI up 0.9%; core up 0.7%.
72	5/11/90	8:29		0.86	0.52	0.28	0.35	US	P	8:30: PPI down 0.3%; core up 0.2%; retail sales down 0.6%.
83	3/19/91	8:29		-0.76	-0.51	-0.22	-0.43	US	P	8:30: CPI up 0.2%; core up 0.7%.
92	11/13/91	8:29		-0.93	-0.34	-0.17	-0.28	US	P	8:30: PPI up 0.7%; core up 0.5%.
93	11/14/91	8:29		0.50	0.15	0.09	0.20	US	P	8:30: CPI up 0.1%; core up 0.1%; retail sales down 0.1%.
108	6/11/93	8:29		0.48	0.79	0.24	0.59	DM	P	8:30: PPI unchanged; core up 0.2%. Retail sales up 0.1%.

Table 3 (continued)

#	Day	Base minute	SP	US	DM	IY	BP	a	b	Event
112	9/10/93	8:29		0.47	0.02	-0.23	-0.01	US	P	8:30: PPI down 0.6%; core down 1.0%.
115	11/9/93	8:29		0.56	0.36	0.13	0.34	US	P	8:30: PPI down 0.2%; core down 0.5%.
120	5/12/94	8:29	0.43	1.05	0.25	0.04	0.15	US	P	8:30: PPI down 0.1%; core up 0.1%; retail sales down 0.8%.
124	9/9/94	8:29	-0.38	-0.74	0.48	0.16	0.26	US	P	8:30: PPI up 0.6%; core up 0.4%.
125	10/13/94	8:29	0.96	0.79	-0.40	-0.29	-0.28	sp	P	8:30: PPI down 0.5%; core up 0.1%.
142	5/10/96	8:29	0.46	0.52	-0.03	-0.02	-0.04	US	P	8:30: PPI up 0.4%; core up 0.1%.
148	9/13/96	8:29	0.84	0.87	0.15	0.05	0.09	sp	P	8:30: CPI up 0.1%; core up 0.1%.
155	4/15/97	8:29	0.78	0.58	0.16	0.05	0.06	sp	P	8:30: CPI up 0.1%; core up 0.2%.
161	8/13/97	8:29	1.42	0.78	-0.26	-0.27	-0.14	sp	P	8:30: PPI down 0.1%; core down 0.1%.
164	10/10/97	8:29	-0.99	-0.84	-0.03	0.08	0.04	sp	P	8:30: PPI up 0.5%; core up 0.4%.
191	5/14/99	8:29	-0.52	-0.91	0.00	0.02	0.02	US	P	8:30: CPI up 0.7%; core up 0.4%.
196	6/16/99	8:29	0.44	0.19	-0.06	-0.08	0.11	sp	P	8:30: CPI unchanged; core up 0.1%.
204	9/10/99	8:29	0.40	-0.05	-0.10	-0.11	-0.06	sp	P	8:30: PPI up 0.5%; core down 0.1%.
205	9/15/99	8:29	0.83	0.41	-0.42	0.22	-0.17	sp	P	8:30: CPI up 0.3%; core up 0.1%.
210	10/15/99	8:29	-1.03	-0.48	0.27	0.23	0.18	sp	P	8:30: PPI up 1.1%; core up 0.8%.
215	12/14/99	8:29	-0.80	-0.33	0.00	-0.04	0.04	SP	P	8:30: CPI up 0.1%; core up 0.2%.
Real Events										
5	8/11/82	14:30	0.19					sp	Y	14:30: Retail sales up 1.0%.
16	12/2/82	14:30	-0.72					sp	Y	14:30: New home sales down 0.4%.
21	9/13/85	9:29		0.76	0.26	0.07	0.26	US	Y	9:30: Industrial production up 0.3%.
23	2/7/86	8:29			-0.41	-0.29	-0.48	DM	Y	8:30: Payrolls up 566,000; wage up 0.2%.
30	4/17/86	8:29			-0.49	-0.51	-0.25	DM	Y	8:30: GDP up 3.2%; deflator up 2.5%.
31	6/13/86	9:14		0.96	0.20	0.21	0.03	US	Y	9:15: Industrial production down 0.6%.
52	11/4/88	8:29			-0.80	-0.58	-0.42	DM	Y	8:30: Payrolls up 323,000; wage up 0.7%.
53	12/2/88	8:29		-1.09	-0.73	-0.41	-0.31	US	Y	8:30: Payrolls up 463,000; wage down 0.1%.
55	2/3/89	8:29		-0.48	-0.09	-0.24	0.21	US	Y	8:30: Payrolls up 408,000; wage up 0.6%.
58	5/5/89	8:29		0.77	0.40	0.23	0.36	US	Y	8:30: Payrolls up 117,000; wage up 0.7%.

Table 3 (continued)

#	Day	Five-minute change (percentage points)		US	DM	JY	BP	a	b	Event
		Base	SP							
		minute								
63	8/4/89	8:29	-0.69	-0.77	-0.77	-0.77	-0.67	US	Y	8:30: Payrolls up 169,000; wage up 0.8%.
68	10/6/89	8:29	0.42	0.61	0.61	0.51	0.32	US	Y	8:30: Payrolls up 209,000; wage up 0.5%.
71	5/4/90	8:29	0.66	0.37	0.37	0.29	0.56	US	Y	8:30: Payrolls up 64,000; wage up 0.3%.
73	6/1/90	8:29	0.91	0.49	0.49	0.33	0.38	US	Y	8:30: Payrolls up 164,000 (all gov.); wage up 0.4%.
81	1/4/91	8:29	-0.80	-0.46	-0.46	-0.45	-0.31	US	Y	8:30: Payrolls down 76,000; wage up 0.6%.
82	2/1/91	8:29	0.91	0.40	0.40	0.45	0.43	US	Y	8:30: Payrolls down 232,000; wage down 0.1%.
86	5/3/91	8:29	-0.39	-1.12	-1.12	-0.54	-0.89	US	Y	8:30: Payrolls down 124,000; wage up 0.5%.
88	8/2/91	8:29	0.76	0.76	0.76	0.50	0.96	US	Y	8:30: Payrolls down 51,000; wage down 0.1%.
89	8/23/91	8:29	-0.67	-0.78	-0.78	-0.21	-0.62	DM	Y	8:30: Durable goods up 10.7%.
91	11/1/91	8:29	0.75	0.12	0.12	0.47	0.28	US	Y	8:30: Payrolls down 1000; wage down 0.1%.
94	1/10/92	8:29	-0.12	-0.91	-0.91	-0.29	-1.24	DM	Y	8:30: Payrolls up 31,000 (-74,000 expected); wage up 0.7%.
96	2/13/92	8:29	-0.40	-0.93	-0.93	-0.29	-0.65	DM	Y	8:30: Retail sales up 0.6%.
97	7/2/92	8:29	1.24	0.88	0.88	0.39	0.54	US	Y	8:30: Payrolls down 117,000; wage up 0.2%.
101	9/4/92	8:29	0.98	1.14	1.14	0.53	0.68	US	Y	8:30: Payrolls down 83,000; wage up 0.7%.
103	10/2/92	8:29	-0.35	-1.13	-1.13	-0.53	-0.87	DM	Y	8:30: Payrolls down 57,000; wage down 0.2%.
104	11/19/92	8:29	0.15	-0.62	-0.62	-0.12	-0.47	DM	Y	8:30: Housing starts down 1.1%.
105	3/5/93	8:29	-0.75	-0.53	-0.53	-0.38	-0.45	US	Y	8:30: Payrolls up 365,000.
107	6/4/93	8:29	-0.54	-0.99	-0.99	-0.33	-0.72	DM	Y	8:30: Payrolls up 209,000; wage up 0.6%.
109	7/2/93	8:29	0.44	0.43	0.43	0.46	0.50	DM	Y	8:30: Payrolls up 13,000; wage down 0.1%.
111	9/3/93	8:29	0.37	0.76	0.76	0.42	0.67	DM	Y	8:30: Payrolls down 39,000; wage up 0.5%.
114	10/8/93	8:29	-0.05	0.46	0.46	0.10	0.35	DM	Y	8:30: Payrolls up 156,000; wage unchanged.
116	1/7/94	8:29	0.10	0.07	0.07	0.10	0.01	US	Y	8:30: Payrolls up 183,000; wage up 0.2%.
117	2/4/94	8:29	0.15	0.40	0.40	0.24	0.44	US	Y	8:30: Payrolls up 62,000; wage up 0.7%.

Table 3 (continued)

#	Day	Five-minute change (percentage points)	US	DM	JP	BP	a	b	Event
		Base SP minute							
118	4/1/94	8:29	-0.97	-0.57	-0.24	-0.29	US	Y	8:30: Payrolls up 456,000; wage up 0.1%.
119	5/6/94	8:29	-0.60	-0.18	-0.12	-0.03	US	Y	8:30: Payrolls up 267,000; wage up 0.3%.
121	7/8/94	8:29	-0.30	-0.11	-0.06	-0.10	US	Y	8:30: Payrolls up 379,000; wage down 0.1%.
122	7/29/94	8:29	0.31	0.70	-0.10	-0.07	US	Y	8:30: GDP up 3.7%; deflator up 2.9%.
123	8/5/94	8:29	-0.35	-0.40	-0.14	-0.16	US	Y	8:30: Payrolls up 259,000; wage up 0.4%.
128	2/3/95	8:29	0.22	0.08	0.09	0.11	US	Y	8:30: Payrolls up 134,000; wage up 0.6%.
129	3/10/95	8:29	-0.24	0.28	0.44	0.10	DM	Y	8:30: Payrolls up 318,000; wage unchanged.
130	3/31/95	8:29	-0.02	-0.03	0.00	0.02	JY	Y	8:30: GDP revised up to 5.1% from 4.7%.
133	6/2/95	8:29	-0.03	0.96	0.72	0.39	US	Y	8:30: Payrolls down 101,000; wage down 0.3%.
134	7/7/95	8:29	-0.20	-0.25	-0.21	-0.19	US	Y	8:30: Payrolls up 215,000; wage up 0.4%.
136	9/1/95	8:29	-0.12	-0.10	-0.22	-0.14	US	Y	8:30: Payrolls up 249,000; wage down 0.2%.
138	3/8/96	8:29	-1.54	-0.25	-0.19		sp	Y	8:30: Payrolls up 705,000 (most in 12 years); wage down 0.1%.
139	4/5/96	8:29	-0.70	-0.28	-0.09	-0.21	US	Y	8:30: Payrolls up 140,000; wage up 0.3%.
140	5/2/96	8:29	-0.35	0.00	0.01	0.04	US	Y	8:30: GDP up 2.8%; deflator up 2.1%.
141	5/3/96	8:29	0.53	0.29	0.14	-0.01	sp	Y	8:30: Payrolls up 2000; wage up 0.6%
143	6/7/96	8:29	-1.86	0.15	0.12	0.10	sp	Y	8:30: Payrolls up 348,000; wage up 0.3%.
144	7/5/96	8:29	-0.93	-0.15	-0.10	-0.10	US	Y	8:30: Payrolls up 239,000; wage up 0.8%.
145	8/1/96	10:00	0.72	0.04	0.04	0.05	US	Y	10:00: NAPM down.
146	8/2/96	8:29	1.38	0.93	0.01	0.01	sp	Y	8:30: Payrolls up 193,000; wage down 0.2%.
147	9/6/96	8:29	-0.25	-0.41	-0.08	-0.06	sp	Y	8:30: Payrolls up 250,000; wage up 0.5%.
149	10/4/96	8:29	0.31	-0.08	-0.04	-0.06	US	Y	8:30: Payrolls down 40,000; wage up 0.5%.
150	1/10/97	8:29	-0.61	0.13	0.14	-0.07	US	Y	8:30: Payrolls up 262,000; wage up 0.5%.
152	1/29/97	8:29	0.59	-0.11	-0.13	-0.05	sp	Y	8:30: Durable goods down 1.7%.
154	3/7/97	8:29	-0.24	-0.34	-0.01	-0.02	sp	Y	8:30: Payrolls up 339,000; wage up 0.2%.
158	6/6/97	8:29	-0.48	-0.24	-0.07	0.00	sp	Y	8:30: Payrolls up 138,000; wage up 0.3%.

Table 3 (continued)

#	Day	Base minute	SP	US	DM	IY	BP	a	b	Event
160	8/1/97	10:00	-0.63	-0.40	-0.06	0.07	0.01	sp	Y	10:00: New orders up 1.2%; strong NAPM report.
162	9/2/97	10:00	0.68	0.47	-0.04	0.04	0.01	sp	Y	10:00: NAPM 56.8 vs 58.6 last month.
163	10/3/97	8:29	0.75	0.88	0.23	0.08	0.11	sp	Y	8:30: Payrolls up 215,000; wage up 0.3%.
165	12/5/97	8:29	-1.12	-0.95	-0.35	-0.13	-0.10	sp	Y	8:30: Payrolls up 404,000; wage up 0.6%.
187	3/5/99	8:29	0.73	1.04	0.29	0.22	0.10	sp	Y	8:30: Payrolls up 275,000; wage up 0.1%.
189	5/7/99	8:29	0.45	0.53	-0.20	-0.16	-0.11	US	Y	8:30: Payrolls up 234,000; wage up 0.2%.
193	6/1/99	10:00	-0.85	-0.37	0.10	0.19	0.05	sp	Y	10:00: NAPM 55.2 vs 52.8 last month.
194	6/4/99	8:29	-0.22	-0.19	0.00	-0.17	-0.04	sp	Y	8:30: Payrolls up 11,000; wage up 0.4%.
199	8/6/99	8:29	-0.57	-0.38	0.08	0.10	0.02	sp	Y	8:30: Payrolls up 310,000; wage up 0.5%.
202	9/3/99	8:29	1.09	0.77	-0.36	-0.16	-0.15	sp	Y	8:30: Payrolls up 124,000; wage up 0.2%.
208	10/8/99	8:29	0.56	0.14	-0.05	0.04	-0.07	sp	Y	8:30: Payrolls down 8000; wage up 0.5%.
212	11/5/99	8:29	0.95	0.38	-0.30	-0.16	-0.18	SP	Y	8:30: Payrolls up 310,000; wage up 0.1%.
214	12/3/99	8:29	0.64	0.34	-0.05	0.04	-0.04	SP	Y	8:30: Payrolls up 234,000; wage up 0.1%.
218	1/7/00	8:29	-0.13		-0.08	-0.05		SP	Y	8:30: Payrolls up 315,000; wage up 0.4%.
220	2/4/00	8:29	0.68	-0.20	-0.20	0.03		SP	Y	8:30: Payrolls up 387,000; wage up 0.4%.
221	3/3/00	8:29	0.80	0.08	0.08	-0.10		SP	Y	8:30: Payrolls up 43,000; wage up 0.3%.
Fiscal policy events										
9	9/14/82	15:29	-0.88					sp	F	15:27: Rostenkowski said tax boost needed for defense.
17	12/9/82	15:21	-0.92					sp	F	?time: Howard Baker withdrew capital gains bill.
18	12/15/82	10:55	-0.73		-0.02	-0.07	0.00	sp	F	10:56: Murray Weidenbaum testified deficit hurts recovery.
24	2/7/86	11:59	-0.98	-0.33	-0.41	-0.13	-0.07	sp	F	12:00: 3 judge panel ruled Gramm-Rudman unconstitutional.

Table 3 (continued)

#	Day	Five-minute change (percentage points)	Base	US	DM	IV	BP	a	b	Event
			SP					sp	F	?time:
		minute								Rubin to announce resignation; Summers is successor.
190	5/12/99	9:45	-1.29	-0.11	0.35	0.75	0.16	sp	F	?time: Rubin to announce resignation; Summers is successor.
Wage events										
151	1/28/97	8:29	0.58	0.60	-0.10	-0.04	-0.01	US	Z	8:30: ECI up 0.8%.
156	4/29/97	8:29	1.09	1.37	0.17	0.06	0.10	sp	Z	8:30: ECI up 0.6%.
169	4/30/98	8:29	1.05	0.74	-0.07	-0.04	0.06	sp	Z	8:30: ECI up 0.7%; GDP up 4.2%; deflator up 0.9%.
219	1/28/00	8:29	-1.41		0.24	0.29		SP	Z	8:30: ECI up 1.1%; GDP up 5.8%; deflator up 2.0%.
Company events										
3	7/13/82	12:18	0.67		0.05	0.08	0.09	sp	C	12:20: IBM profits \$1.68 vs \$1.37 year ago.
8	8/24/82	13:38	-0.35		-0.07	0.03	-0.08	sp	C	13:40: GM mid August sales down to \$1,597 from \$1,949.
22	1/17/86	9:54	-0.55	-0.07	-0.02	0.00		sp	C	9:54: IBM profits \$4.36 vs \$3.55 year ago.
217	1/6/00	16:04	-0.85		0.10	0.03		SP	C	?time: Lucent's earnings below expectations.
Trade gap events										
34	12/31/86	8:29			0.50	0.38	0.31	DM	T	8:30: Trade gap widened to \$19.22 billion.
35	1/30/87	8:29			-1.36	-0.67	-0.25	DM	T	8:30: Trade gap narrowed to \$10.66 billion.
36	7/15/87	8:29			0.52	0.63	0.32	JY	T	8:30: Trade gap widened to \$14.40 billion.
37	8/14/87	8:29			1.17	1.49	0.60	DM	T	8:30: Trade gap widened to \$15.71 billion.
38	9/11/87	8:29			1.06	1.02	0.75	DM	T	8:30: Trade gap widened to \$16.47 billion.
39	10/14/87	8:29			0.51	0.67	0.32	DM	T	8:30: Trade gap narrowed to \$15.68 billion.
41	1/12/87	8:29			-0.74	-0.54	-0.40	DM	T	8:30: Trade gap narrowed to \$14.05 billion.
42	12/10/87	8:29			2.37	1.27	2.37	DM	T	8:30: Trade gap widened to \$17.63 billion.
43	1/15/88	8:29			-2.50	-3.16	-1.95	DM	T	8:30: Trade gap narrowed to \$13.22 billion.
44	2/12/88	8:29			-1.00	-1.78	-1.05	DM	T	8:30: Trade gap narrowed to \$12.20 billion.
45	3/17/88	8:29			-0.20	-0.66	-0.17	JY	T	8:30: Trade gap widened to \$12.44 billion.
46	4/14/88	8:29			1.58	1.59	1.30	DM	T	8:30: Trade gap widened to \$13.83 billion.
47	5/17/88	8:29			-1.11	-1.12	-1.15	DM	T	8:30: Trade gap narrowed to \$9.75 billion.

Table 3 (continued)

#	Day	Five-minute change (percentage points)		US	DM	JY	BP	a	b	Event	
		Base	SP								
		minute									
48	6/14/88	8:29		-0.62	-0.19	-0.75	DM	T		8:30: Trade gap narrowed to \$9.89 billion.	
49	8/16/88	8:29		1.60	0.26	0.35	DM	T		8:30: Trade gap widened to \$12.54 billion.	
50	9/14/88	8:29		-0.79	-0.85	-0.60	DM	T		8:30: Trade gap narrowed to \$9.53 billion.	
51	10/13/88	8:29		0.84	0.89	0.64	DM	T		8:30: Trade gap widened to \$12.18 billion.	
54	1/18/89	8:29		0.46	0.51	0.63	BP	T		8:30: Trade gap widened to \$12.51 billion.	
60	5/17/89	8:29	-0.28	-0.85	-0.75	-0.94	DM	T		8:30: Trade gap narrowed to \$8.86 billion.	
62	6/15/89	8:29	-0.07	-0.71	-0.48	-0.34	DM	T		8:30: Trade gap narrowed to \$8.26 billion.	
65	8/17/89	8:29	0.29	-0.68	-0.43	-0.77	BP	T		8:30: Trade gap narrowed to \$8.17 billion.	
66	9/15/89	8:29	0.29	-1.00	-0.66	-0.94	DM	T		8:30: Trade gap narrowed to \$7.58 billion.	
70	10/17/89	8:29	0.00	0.56	0.55	0.58	DM	T		8:30: Trade gap widened to \$10.77 billion.	
110	7/16/93	8:29		-0.19	-0.78	-0.27	JY	T		8:30: Trade gap narrowed to \$8.37 billion.	
137	10/18/95	8:29	0.07	-0.89	-0.55	-0.35	DM	T		8:30: Trade gap narrowed to \$8.80 billion.	
Rumor and comment events											
7	8/19/82	14:02	-0.55	0.05	0.05	0.00	sp	X		?time: Rumor major US bank in trouble over Mexican loans.	
20	2/26/85	11:20	0.17	1.07	0.13	0.48	DM	X		?time: Volcker testified maybe more FX intervention needed.	
25	2/19/86	11:37	-0.04	-0.73	-0.64	-0.50	JY	X		?time: Volcker testimony.	
26	2/19/86	12:36	0.02	-0.48	-0.48	-0.44	DM	X		?time: Volcker voiced worry over value of dollar.	
27	2/27/86	10:54	0.07	-0.55	-0.65	-0.24	DM	X		?time: Preston Martin denied rumor about G5 meeting.	
33	10/31/86	8:29		-0.49	-0.16	-0.14	DM	X		?time: James Baker hailed Japanese rate cut.	
40	11/0/87	10:45	0.48	-0.36	-0.23	-0.29	DM	X		?time: Reagan said he wanted no further dollar decline.	
77	10/5/90	11:03	0.32	-0.69	-0.04	0.46	DM	X		11:09: UK cut rate by 100bp: pound to enter ERM.	

Table 3 (continued)

#	Day	Base SP minute	US	DM	IY	BP	a	b	Event
78	10/9/90	15:41	-0.81				sp	X	15:39: Brazil's central bank president said rescheduling needed.
84	4/5/91	9:32	0.01	-0.74	-0.49	-0.54	DM	X	9:32: Bundesbank said dollar rise not from fundamentals.
95	1/17/92	13:28	-0.08	0.36	0.85	0.31	JY	X	13:32: Schlesinger said monetary stability in peril.
102	9/16/92	14:46	-0.08	0.85	0.41	1.69	DM	X	14:43: Bank of England to suspend pound from ERM.
131	4/26/95	10:12	0.06	-0.22	-0.54	-0.19	JY	X	?time: G10 concerned over recent FX moves.
159	6/11/97	23:36		-0.03	-1.17		JY	X	?time: Sakakibara warned about too strong a yen.
173	8/11/98	20:16		0.12	0.70		JY	X	?time: Kuroda: will take necessary FX steps.
179	11/16/98	20:58		-0.03	-0.22		JY	X	21:01: Moody's cuts Japan's FX rating to AA1.
183	1/11/99	20:05	0.05		-0.91		JY	X	?time: Miyazawa: no comment on whether will intervene.
184	1/12/99	2:12	0.04		-0.86		JY	X	?time: Nonaka: excessive yen rise not good.
185	1/15/99	8:07	0.81				sp	X	8:10: Estado said Brazil won't intervene in FX market
201	8/24/99	20:12	-0.01		-0.61		JY	X	?time: Mitoguchi: will watch FX market after Fed meeting.
International conflict events									
74	8/3/90	9:46	-0.72	0.13	0.13	0.09	sp	W	?time: Iraq invaded Kuwait.
75	8/17/90	12:13	-0.46	0.06	0.07	-0.01	sp	W	12:11: Pentagon recommended maybe calling up reserves.
76	8/21/90	11:13	0.98	-0.03	-0.10	-0.02	sp	W	11:13: Iraq's Aziz said he is ready to discuss Gulf situation.

Table 3 (continued)

#	Day	Five-minute change (percentage points)	US	DM	BY	BP	a	b	Event
		Base SP							
		minute							
79	10/12/90	11:53	0.50	0.06	0.05	0.02	sp	W	11:51: Exile party said Iraq considering withdrawal.
80	12/4/90	15:32	0.99				sp	W	?time: British TV reported Iraq made new offer on Kuwait.
113	9/21/93	12:16	-0.01	-0.72	-0.12	-0.79	DM	W	12:16: Yeltsin suspended parliament.
135	8/17/95	14:42	0.03	0.43	0.84	0.34	JY	W	?time: Iraq warned US military steps will backfire.
International									
events									
19	10/25/84	10:15	-0.03	0.87	0.41	0.45	DM	I	10:21: Bundesbank intervened,
99	7/20/92	10:15	0.19	-0.51	-0.31	-0.32	DM	I	?time: Coordinated intervention.
100	8/21/92	9:19	-0.03	-0.78	-0.24	-0.46	DM	I	?time: Fed intervention.
126	11/2/94	11:00	0.12	-0.66	-0.69	-0.48	DM	I	?time: US intervention.
132	5/31/95	8:35	-0.03	-0.86	-1.16	-0.47	DM	I	?time: US intervention
166	1/5/98	19:50	-0.05	0.04	0.89	0.04	JY	I	?time: Japan intervened.
167	3/19/98	19:38	0.02		0.74		JY	I	?time: Japan intervened.
170	6/17/98	7:54	0.05	0.27	1.23	0.23	JY	I	?time: US and Japan intervened.
171	6/24/98	2:31	0.04	0.22	0.92		JY	I	?time: Japan intervened.
195	6/13/99	20:10		-0.06	-0.56	-0.16	JY	I	?time: Japan intervened.
198	7/20/99	9:07	0.04	-0.29	-0.87	-0.09	JY	I	?time: US intervened.
213	11/30/99	1:20			-0.56		JY	I	?time: Japan intervention removed.
Japan									
events									
28	3/6/86	9:44	-0.11	0.07	0.31	0.0	US	J	9:43: Source said BOJ reducing discount rate by 50bp.
168	4/9/98	4:05	0.04	-0.16	-0.58		JY	J	?time: Hashimoto announced tax cuts.
172	7/2/98	23:14			0.75		JY	J	?time: Hashimoto talked of permanent tax cuts.

Table 3 (continued)

#	Day	Base minute	SP	US	DM	BY	BP	a	b	Event
174	9/9/98	5:17			-0.09	-1.33	-0.07	JY	J	?time: BOJ cut rate to 0.25.
176	10/13/98	3:09			0.30	0.83		JY	J	?time: BOJ kept policy unchanged.
178	11/12/98	11:45	0.02	-0.05	0.10	0.23	0.04	JY	J	?time: Japan stimulus package announced.
181	11/19/98	21:37			-0.10	-1.03		JY	J	?time: Miyazawa: no sales tax cut for now. debate possible.
182	1/7/99	5:22	0.00		-0.08	-0.86	0.02	JY	J	?time: Japan's consumer spending up; recovery seems distant.
200	8/13/99	8:57	0.11	0.00	-0.52	-0.98	-0.26	JY	J	?time: Ozawa's Liberal party to stay in ruling block.
203	9/8/99	19:49	-0.08		1.02	1.80		JY	J	?time: Japanese GDP 0.9%; deflator -0.7%.
206	9/21/99	3:54	-0.31		1.80			JY	J	?time: BOJ policy unchanged.
209	10/13/99	5:15	0.00		0.05	-0.90		JY	J	?time: BOJ policy eased.
211	10/27/99	3:13	0.02		-0.02	-0.54		JY	J	?time: Sony's profits down 24.5%.
Germany events										
67	10/5/89	9:00		-0.10	0.49	0.31	0.68	BP	G	9:02: Bundesbank raised rate by 100bp.
87	7/12/91	9:15		0.00	0.93	0.21	0.62	DM	G	9:14: Germany to take phased approach to inflation.
106	4/22/93	9:15		-0.08	-0.08	0.02	-0.01	DM	G	9:16: Bundesbank Cut Lombard rate and discount rate.
188	3/11/99	11:44	-0.05	0.08	0.61	0.44	0.16	DM	G	?time: Lafontaine resigned.

^a See Table 2 for notes and abbreviations

mate time of the event (which is known from the searching), and the plots were examined for price jumps. The base minute was taken to be the minute right before the price jump. In almost all cases it was obvious where the price jump occurred—at most the error in choosing the base minute is a minute. In the few cases where it was not obvious, judgment had to be used, and in these cases the error could be as large as three or four min. The base minute chosen for each event is presented in Table 2.

It may be for a given variable that the price level for min 0 and/or min 5 does not exist. When this was true, the following price-level pairs were tried in the order specified, and the procedure was stopped when data for a pair existed. If at the end no pairs existed, no change is presented in Table 2. (The notation $-i$ is the i 'th minute before min 0.) The order of the pairs tried is (when 5/0 does not exist): 6/0, 4/0, 3/0, 2/0, 1/0, 5/-1, 5/-2, 5/-3, 5/-4, 6/-1, 4/-1, 3/-1, 2/-1, 1/-1, 6/-2, 4/-2, 3/-2, 2/-2, 1/-2, 6/-3, 4/-3, 3/-3, 2/-3, 1/-3, 6/-4, 4/-4, 3/-4, 2/-4, 1/-4.

Note that it may be that no change for an event in Table 2 is greater than 0.75 in absolute value. It may be, for example, that only the three-minute change was this large, and it is not presented in the table. The maximum of the one- through five-min changes for each variable could have been used in Table 2, but for comparison purposes across variables it seemed better to use (whenever possible) the same change for each.

It is important to stress that each event in Table 2 is causal in that it caused the large price changes. For example, it is almost certain that the five-min SP price increase of 1.05% on June 25, 1982, was essentially all due to the 16:10 money supply announcement (event 1, Table 2). There would likely have been, of course, a price change had there been no announcement, since the price generally changes each minute, but with a standard deviation of 0.107%, a typical price change is very small relative to a change of 1.05%. For all intents and purposes one can attribute all of the price change to the money supply announcement. A way of thinking about the events is the following. Consider asking stock or bond or exchange rate brokers a few minutes after the occurrence of one of the large price changes in Table 2 what, if anything, led to the change. The main point here is that almost without exception the brokers would say the event.

There are two possible types of errors regarding the construction of Table 2. One is that the event that was chosen did not in fact cause the large price changes. It may be that a few events, especially those put in category X, have been chosen in error, but there are not likely to be many of these. Almost all the chosen events are the obvious causal events for the large price changes. When, for example, there is a large price jump between the end of min 8:29 and the end of min 8:30 and there was a widely followed announcement at 8:30, it is obvious that the announcement was the cause. There is little possibility of error here.

The other type of possible error is that an event was missed for a large price change. The most likely error is an event for which there was no news report. Less likely is a news report that was listed in the search but that was not noticed as an important event. It is difficult to know how many errors of this type were made, but there are clearly likely to be some. So Table 2 should at least be a little larger than

it is. Note also that many more large price changes and events would likely have been found had the GLOBEX market been in existence prior to 1994. For the sake of the analysis in Section 4, the missing of events cuts the number of observations that are available for study, so efficiency is lost, but there is no necessary bias introduced. More will be said about sample selection in Section 4.

It should be stressed that the events that have been found are not necessarily surprises in the sense of an actual value differing from an expected value, although most of them probably are. Even if the actual value is equal to the expected value, the relieving of uncertainty may affect prices. (Jones et al. (1998), for example, find that prices tend to rise on announcement days, which they attribute to an announcement risk premium.) In the rest of this paper, however, the word ‘surprise’ will be used to describe the events, but keep in mind this caveat.

Aside from examining the relationship among variables, which is done in the next section, Table 2 may be of interest in its own right for other studies. The events are large surprises in that they caused a large and rapid price change in at least one financial instrument. Also, the *sign* of the effect of each surprise on each financial instrument is known. Knowledge of these events may prove useful in both macroeconomic studies and studies of individual stock prices.

4. Relationships among the variables

4.1. The bond price (US) and stock price (SP)

If the bond price (US) depends negatively on expected future short term interest rates, which is assumed here, then an event that decreases US is one in which there is an increase in expected future short rates.

It will be useful to organize the discussion around three ‘propositions’. These propositions are hypotheses about the signs of three types of events on various expectations and the signs of the expectations on the stock price (SP). It will be seen that the propositions have implications that are supported by the data in Table 3. The propositions are stated for events that decrease US, but everything is meant to hold in reverse for events that increase US.

Proposition 1. Consider a monetary event (R) that decreases US by amount x . This has a negative effect (effect 1) on SP for two reasons. First, expected future discount rates are higher. Second, expected future earnings are lower due to an expected slower future economy caused by the expected higher interest rates.

Proposition 2. Consider a price event (P) that decreases US by amount x . This has effect 1 on SP, which is negative, from Proposition 1. Also, if the price event is a positive price surprise, which is assumed here, this has a positive effect on expected future earnings in nominal terms, which has a positive effect (effect 2) on SP.

Proposition 3. Consider a real event (Y) that decreases US by amount x . This has effect 1 on SP, which is negative, from Proposition 1. Also, if the real event is a positive real surprise, which is assumed here, this has a positive effect on the

expected future economy and thus on expected future earnings, which has a positive effect (effect 3) on *SP*. Finally, if the positive real surprise is also in part a positive price surprise, effect 2 from Proposition 2 is at work, which has a positive effect on *SP*.

What do these three propositions imply about the data in Table 3? The relevant data are the *R*, *P*, and *Y* events for which observations on both ΔSP and ΔUS exist, where ΔSP and ΔUS are the five-min percentage changes in *SP* and *US* in the table. There are 12 *R* events, 14 *P* events, and 38 *Y* events that meet this requirement, for a total of 64 observations.

Only four of the 64 observations have ΔSP and ΔUS of opposite signs—2 for the *R* events (events 175 and 216), 1 for the *P* events (event 204), and 1 for the *Y* events (event 133). Although Proposition 1 says that the signs should be the same for the *R* events (effect 1 is negative), Propositions 2 and 3 say that the signs could go either way for the *P* and *Y* events (effects 2 and 3 are positive). Given that the signs of ΔSP and ΔUS for the *P* and *Y* events are almost always the same, it is clear that effect 1 dominates effects 2 and 3.

The key implication from the three propositions, however, does not concern the sign of the changes, which as just noted can go either way for the *P* and *Y* events, but the *size* of ΔSP relative to *size* of ΔUS . The three propositions imply that the *SP* response relative to the *US* response should be smaller for the *P* and *Y* events than for the *R* events. This is because effects 2 and 3 are positive and therefore offset some of effect 1, which is negative.

Note that having observations on both *SP* and *US* is crucial for examining this implication. Events differ in the size of their impact on expected future short term interest rates, and a measure of the size of the impact of a given event on expected future rates is ΔUS . Examining ΔSP relative to ΔUS is a way of accounting for the different sizes of the impacts.

The propositions also imply that the *SP* response relative to the *US* response is likely to be smaller for *Y* events than for *P* events because effect 3 is only operating for *Y* events. This is true unless for a given change in *US* effect 2 is much larger for a *P* event than for a *Y* event and results in effect 2 for the *P* event being larger than the sum of effects 2 and 3 for the *Y* event. As will be seen, the data suggest that this is not the case.

These implications can be examined by regressing ΔSP_i on ΔUS_i :

$$\Delta SP_i = \alpha \Delta US_i + \varepsilon_i, \quad (1)$$

where *i* denotes either a *R*, *P*, or *Y* observation. The propositions imply that α should be larger for the *R* observations than for the *P* and *Y* ones. They also imply that α is likely to be larger for the *P* observations than for the *Y* ones.

Regarding sample selection issues, recall from Section 3 that some events may have been missed in the newswire searches. This does not in itself, however, bias the estimates of α . It simply affects the number of observations that are used. There is also no bias introduced from using the particular trigger of 0.75%. If, say, 0.5% had been used, more events would likely have been found, but again this just affects the number of observations. The advantage of using a large trigger is that essentially

all of the change in SP and all of the change in US are caused by the event. This is not necessarily the case for small triggers. In future work, however, it may be useful to use a smaller trigger (or at least a smaller trigger for US , which has a smaller standard deviation than does SP) to gather more observations.

The theory implies that α is different across the three types of events, and so according to the theory α is obviously not constant across all observations. If α were constant, however, would the estimate of α be biased using only the observations in Table 2 (for which data on both ΔSP and ΔUS exist)? If the distributions of ΔUS_i and ϵ_i (and thus the distribution of ΔSP_i) are symmetric around zero and if the expected value of ϵ_i given ΔUS_i is zero, then no bias is introduced by limiting the sample to observations in the left and right tails of the distributions of ΔSP_i and ΔUS_i . The symmetry assumption does not seem unreasonable in the present context, and so it seems unlikely that there would be much bias using only the extreme observations if α were in fact constant across all observations.

Note also that even if there were some bias from using the extreme observations, there is no reason to think that the size of the bias would differ across the R , P , and Y events. Therefore, there should be little bias in the differences in estimates of α , which is the concern here.

The estimates of α are presented in the top half of Table 4 for the three sets of observations. The estimate is 1.68 for the R observations, 1.03 for the P observations, and 0.75 for the Y observations. This is exactly as expected. The difference between 1.68 and 1.03 has a t -statistic of 1.37, and the difference between 1.68 and 0.75 has a t -statistic of 2.08⁵. The R and Y difference is thus statistically significant, but the

Table 4
Estimates of α for different events^a

$\Delta SP_i = \alpha \Delta US_i + \epsilon_i$					
	Event observations				
	R	P	Y		
(# obs.)	(12)	(14)	(38)		
$\hat{\alpha}$	1.68	1.03	0.75	t-stat. R vs $P=1.37$	t-stat. R vs $Y=2.08$
				t-stat. P vs $Y=1.28$	
ΔDM_i , or ΔJY_i , or $\Delta BP_i = \alpha \Delta US_i + \epsilon_i$					
	Event observations				
	R	P	Y		
(# obs.)	(14)	(27)	(66)		
DM $\hat{\alpha}$	0.41	0.15	0.34	t-stat. R vs $P=1.11$	t-stat. Y vs $P=1.72$
JY $\hat{\alpha}$	0.17	0.09	0.21	t-stat. R vs $P=0.52$	t-stat. Y vs. $P=1.64$
BP $\hat{\alpha}$	0.53	0.14	0.24	t-stat. R vs $P=2.02$	t-stat. Y vs $P=1.15$

^a Observations used for the regressions are from Table 3. R =monetary events; P =price events; Y =real events

⁵ These t -statistics were computed by regressing over all 64 observations ΔSP_i on ΔUS_i , $DP_i \Delta US_i$, and $DY_i \Delta US_i$, where DP_i is 1 for the P observations and 0 otherwise and DY_i is 1 for the Y observations and 0 otherwise. The t -statistic for the estimate of the coefficient of $DP_i \Delta US_i$ is the t -statistic for the difference between the R observations α and the P observations α , and the t -statistic for the estimate of

R and P difference is not. The t -statistic for the difference between 1.03 and 0.75 is 1.28, and so the P and Y difference is also not statistically significant. Given the small sample sizes, however, one cannot expect much precision, and it is at least encouraging that the relative sizes are as expected. If the two R observations are omitted that have the opposite signs for ΔUS_i and ΔSP_i (events 175 and 216), the estimate of α for the R observations rises to 2.25 with the t -statistic for the difference between the R and Y observations rising to 4.00 and the t -statistic for the difference between the R and P observations rising to 3.08. The results thus provide some support to the existence of effects 2 and 3, especially effect 3.

Some of the other results in Table 3 regarding ΔSP and ΔUS are the following. The three wage (Z) observations are similar to the price ones. The estimate of α for the three observations is 0.94, which is close to the 1.03 for the P observations. One might expect wage events to have a smaller effect on expected future nominal earnings than do price events because of higher expected wage bills, which means that α should be larger for the wage events than for the price events. In fact the estimates are essentially the same.

The fiscal policy (F), company (C), and international conflict (W) events seem likely to have more effect on expected future earnings than on expected future interest rates. It is generally the case in Table 3 that the large changes from these events are on SP and not on US . Economists might find event 190 particularly interesting, where fear of Larry Summers drove SP down by 1.29% in five minutes.

4.2. The bond price (US) and exchange rates (DM, JY, BP)

Consider now the relationship between the bond price (US) and the exchange rates (DM, JY, BP). (Remember that the euro replaces the deutsche mark beginning June 1, 1999.) An exchange rate is the dollar price of the currency, so that an increase in an exchange rate is an appreciation of the currency and thus a depreciation of the dollar. In what follows all changes in US variables are meant to be both *absolute* and *relative* to the respective variables for Germany, Japan, and the UK. Again, it will be useful to organize the discussion around three propositions.

Proposition 4. Consider a monetary event (R) that decreases US by amount x . This has two effects on DM, JY , and BP , one negative and one positive. The negative effect (effect 4) is because investors seek the higher expected rates of return in the United States, which drives the price of the dollar up. The positive effect (effect 5) is because of an expected slower US economy and lower stock prices caused by the expected higher US interest rates.

Proposition 5. Consider a price event (P) that decreases US by amount x . This has effects 4 and 5 on DM, JY , and BP , one negative and one positive, from Proposition 4. Also, if the price event is a positive price surprise, which is assumed here,

the coefficient of $DY\Delta US_i$ is the t -statistic for the difference between the R observations α and the Y observations α . The t -statistic for the difference between the P observations α and the Y observations α is obtained in a similar manner—from a regression of ΔSP_i on ΔUS_i , $DY\Delta US_i$, and $DR_i\Delta US_i$, where DR_i is 1 for the R observations and 0 otherwise.

this has a positive effect (effect 6) on the exchange rates because expected future US prices are higher, which encourages investors to seek to move out of dollars and thus drives the price of the dollar down.

Proposition 6. Consider a real event (Y) that decreases US by amount x . This has effects 4 and 5 on DM, JY, and BP, one negative and one positive, from Proposition 4. Also, if the real event is a positive real surprise, which is assumed here, this has a negative effect (effect 7) on the exchange rates because it has a positive effect on the expected future US economy and US stock prices. This encourages investors to seek to move into dollars and thus drives the price of the dollar up. Finally, if the positive real surprise is also in part a positive price surprise, effect 6 from Proposition 5 is at work, which has a positive effect on the exchange rates.

The relevant data in Table 3 for these three propositions are the R , P , and Y events for which observations on ΔUS , ΔDM , ΔJY , and ΔBP exist. There are 14 R events, 27 P events, and 66 Y events that meet this requirement, for a total of 107 observations.

In the following discussion DM will be used as the exchange rate, but the same analysis holds for JY and BP . A key implication from Propositions 4 and 5 is that the size of ΔDM relative to size of ΔUS should be smaller for the P events than for the R events. This is because effect 6 for the P event is positive and therefore offsets some of the negative effect from effect 4 for the P event.

The propositions also imply that ΔDM relative to ΔUS should be smaller for the P events than for the Y events because effect 7 is only operating for the Y events. This is true unless effect 6 is much larger for a P event than for a Y event and results in effect 6 for the P event being larger than the sum of effects 6 and 7 for the Y event. As will be seen, the data suggest that this is not the case. Propositions 4 and 6 have no implications for R versus Y events. Effects 6 and 7 are working for Y events and not for R events, but effect 6 is positive and effect 7 is negative.

These implications can be examined by regressing ΔDM_i on ΔUS_i :

$$\Delta DM_i = \alpha \Delta US_i + \varepsilon_i, \quad (2)$$

where i denotes either a R , P , or Y observation. The propositions imply that α should be smaller for the P observations than for the R ones. They also imply that α is likely to be smaller for the P observations than for the Y ones.

The estimates of α are presented in the bottom half of Table 4 for the three sets of observations and the three exchange rates. For all three exchange rates the estimate of α is smaller for the P observations than for the R and Y observations, which is as expected. The three t-statistics for the R versus P differences are 1.11, 0.52, and 2.02, and the three t-statistics for the Y versus P differences are 1.72, 1.64, and 1.15. Again, even though the precision is not high, it is at least encouraging that all six of the relative sizes are as expected. The results provide some support to the existence of effects 6 and 7.

The other results in Table 3 for the exchange rates require little further discussion. For all 25 of the US trade gap (T) events the signs of the three exchange rate changes are the same, as expected. The trade events relate to the US trade balance, and so the dollar should be affected across all currencies. It is interesting to note that the last trade gap announcement to have a large effect was October 18, 1995 (event

137). Market participants no longer seem to worry much about the US trade deficit. Each intervention (an *I* event) has a large effect on at least one of the exchange rates.

5. Conclusion

The 221 events in Table 2 are important events in that they caused a large and rapid change in one or more of the US stock market, the US bond market, the market for deutsche marks, the market for yen, and the market for British pounds. Knowledge of these events may be useful in future work. As discussed at the end of Section 3, the events have the advantage that they are truly surprises and that the sign of their effect of each surprise on each financial instrument is known.

Knowledge of the events was used in Section 4 to examine the effects of three different types of events: monetary, price, and real. Assume that the event is one that led to a decrease in the bond price *US* (an increase in the US interest rate). Seven effects were postulated for events that decrease *US*:

- Effect 1: Negative effect of a monetary event on *SP* because expected future discount rates are higher and expected future earnings are lower.
- Effect 2: Positive effect of a price event on *SP* because of the positive effect on expected future nominal earnings.
- Effect 3: Positive effect of a real event on *SP* because of the positive effect on expected future earnings.
- Effect 4: Negative effect of a monetary event on exchange rates because investors seek the higher expected US rates of return.
- Effect 5: Positive effect of a monetary event on exchange rates because of the expected lower US stock prices.
- Effect 6: Positive effect of a price event on exchange rates because of higher expected US goods prices.
- Effect 7: Negative effect of a real event on exchange rates because of the positive effect on expected future US stock prices.

The implications of Propositions 1–6 in Section 4 are supported by the data. The change in the stock price (*SP*) relative to the change in the bond price (*US*) is larger for monetary events than for price and real events and larger for price events than for real events. The change in an exchange rate (*DM*, *JY*, or *BP*) relative to the change in the bond price is smaller for price events than for monetary and real events. In terms of the seven effects, the results suggest that while effects 1, 4, and 5 are strong, there is some support for the existence of effects 2, 3, 6, and 7.

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