

# **Using Financial Markets to Detect Illegal Transactions.**

## **The Case of the Arms Trade**

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# Motivation



- Armed violence was responsible for 80,000-108,000 *direct* deaths in 2003.  
  
Total **death toll** is several times greater (e.g., war in Democratic Rep. Congo caused 3.8 million deaths since 1998).
- Significant portion of arms used in civil conflicts is imported **illegally**
- Few means of preventing illegal arms flows. Most widely accepted is arms **embargoes**

# Embargoes



## The norm

- “States have a **legal obligation** to comply strictly with arms embargoes imposed by the Security Council under the authority of Chapter VII of the UN Charter”

## Rarely used

- According to SIPRI, there were 57 major armed conflicts in 1990-2001, yet only **eight** were subject to UN arms embargoes

## Always violated

- Each and **every one** of the 13 UN embargoes imposed in the last decade has been violated.

## Embargoes (cont'd)



- Yet, *direct evidence* on embargo violations and illegal arms exports is extremely difficult to provide.

(Sanctions Committee of UN Security Council relies on investigative teams)

This paper:

Use *financial market reactions* to news about conflict deterioration or improvement (hence about demand for arms) to *indirectly* assess the presence of illegal transactions

# How



- Take all **countries** subjected to arms embargoes
- Collect **news** about evolution of the conflict before & during embargo
- Test if stock returns of arms producing companies respond to unexpected events
  - Increased or decreased conflict intensity **during** embargo
- (Test robustness to different methodologies and cross-validate using secondary sources)

# Too much investor rationality?



## *Example: Maloney-Mulherin (2003)*

- Jan. 28, 1986: Challenger shuttle explodes
  - All rocket makers are down
  - Hardest hit company: Morton Thiokol
- Weeks later: O-ring (produced by Morton Thiokol) found responsible for explosion
- Someone knew and invested... (NYT, 11/3/2006)

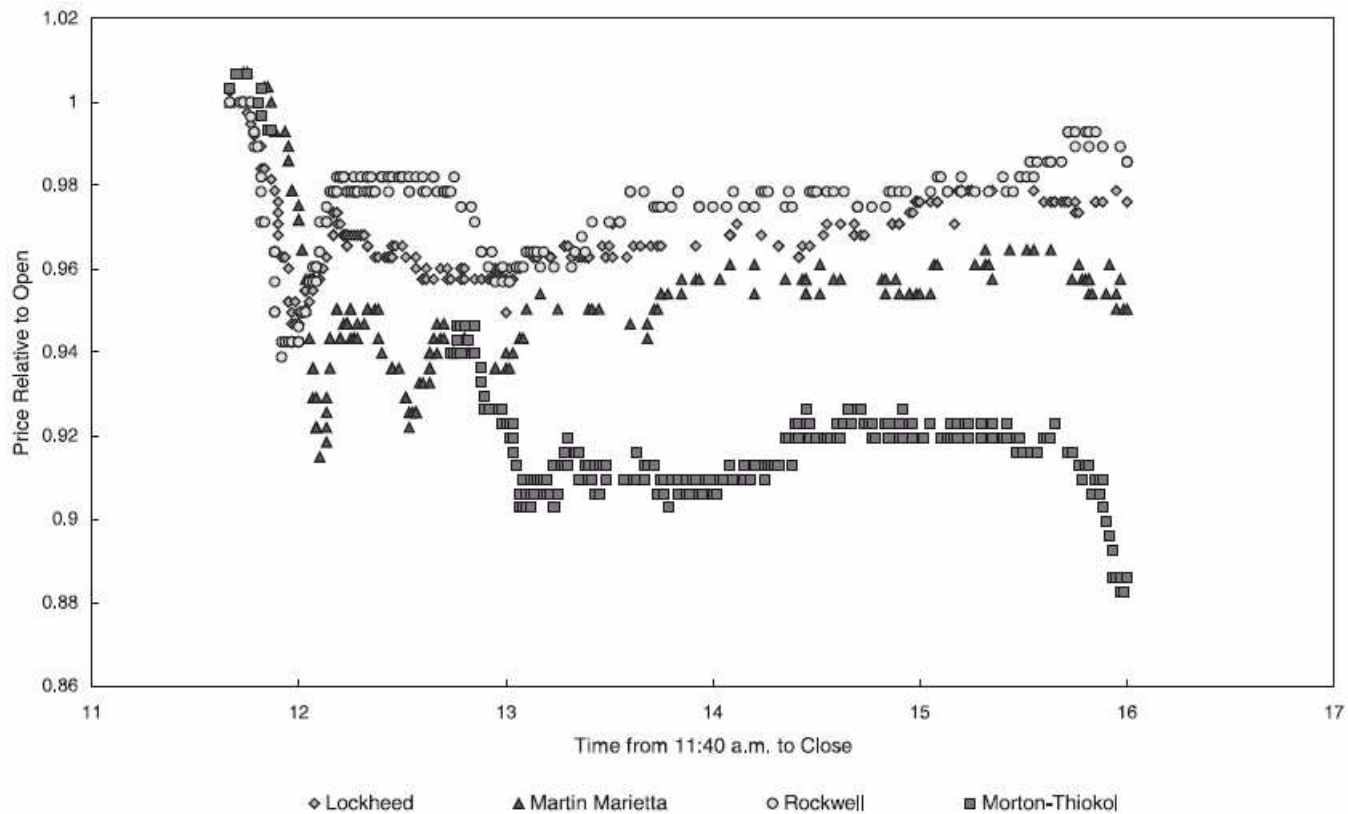
## Challenger example (cont'd)

Daily stock market behavior around the challenger crash

Variable	Morton Thiokol	Lockheed	Martin Marietta	Rockwell International
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*Panel A. Daily stock returns*

January 28	- 11.86%	- 2.14%	- 3.25%	- 2.48%
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# Related literature



- “Forensic economics”: Use large datasets to detect corruption

Duggan-Levitt (2002); Jacob-Levitt (2003); Wolfers (2006)

- Insider trading literature: Pre-earnings-announcement stock price movements

- Event studies and political events

Roberts (1990); Fisman (2001); Johnson-Mitton (2003);  
Abadie-Gardeazabal (2003), Guidolin-La Ferrara (2004)



# Outline



- Data
  - Embargoes
  - Conflicts
  - Companies
- Detecting individual companies: an example
  - Methodology
  - Results
- Aggregate reactions: regressions
  - Specification
  - Results

# Data: Embargoes

## Full list of UN arms embargoes



Country	Date imposed	Date lifted	Res. No.	By
South Africa	4 Nov 1977	24 May 1994	UNSCR 418	UN
Iraq	6 Aug 1990	--	UNSCR 661	UN
Former Yugoslavia	25 Sep 1991	1 Oct 1996	UNSCR 713	UN
	31 Mar 1998	--	UNSCR 1160	UN
Somalia	23 Jan 1992	--	UNSCR 733	UN
Libya	31 Mar 1992	9 Dec 2003	UNSCR 748	UN
Liberia	19 Nov 1992	--	UNSCR 788	UN
Haiti	13 Oct 1993	15 Oct 1994	UNSCR 841	UN
Angola (UNITA)	15 Sep 1993	9 Dec 2002	UNSCR 864	UN
Rwanda	17 May 1994	16 Aug 1995	UNSCR 918	UN
(rebels)	16 Aug 1998	--	UNSCR 1011	UN
Sudan	15 Mar 1994	28 Sept 2001	94/165/CFSP	UN
	Nov 2001	--		US
	9 Jan 2004	--		EU
	30 Jul 2004	--	UNSCR 1556	UN
Sierra Leone	8 Oct 1997	5 Jun 1998	UNSCR 1132	UN
(rebels)	5 Jun 1998	--	UNSCR 1171	UN
Ethiopia & Eritrea	17 May 2000	16 May 2001	UNSCR 1298	UN
Afghanistan (Taliban)	19 Dec 2000	--	UNSCR 1267	UN

## Embargoes (cont'd)



### Selection criteria

- Imposed after 1980 (stock price data)
- Last long enough to have salient unexpected conflict events during embargo
- No massive US intervention

## Embargoes (cont'd)



### Embargoes in our sample

Country	Date imposed	Date lifted	Res. No.	By
South Africa	4 Nov 1977	24 May 1994	UNSCR 418	UN
Iraq	6 Aug 1990	--	UNSCR 661	UN
Former Yugoslavia	25 Sep 1991	1 Oct 1996	UNSCR 713	UN
	31 Mar 1998	--	UNSCR 1160	UN
Somalia	23 Jan 1992	--	UNSCR 733	UN
Libya	31 Mar 1992	9 Dec 2003	UNSCR 748	UN
Liberia	19 Nov 1992	--	UNSCR 788	UN
Haiti	13 Oct 1993	15 Oct 1994	UNSCR 841	UN
Angola (UNITA)	15 Sep 1993	9 Dec 2002	UNSCR 864	UN
Rwanda	17 May 1994	16 Aug 1995	UNSCR 918	UN
(rebels)	16 Aug 1998	--	UNSCR 1011	UN
Sudan	15 Mar 1994	28 Sept 2001	94/165/CFSP	UN
	Nov 2001	--		US
	9 Jan 2004	--		EU
	30 Jul 2004	--	UNSCR 1556	UN
Sierra Leone	8 Oct 1997	5 Jun 1998	UNSCR 1132	UN
(rebels)	5 Jun 1998	--	UNSCR 1171	UN
Ethiopia & Eritrea	17 May 2000	16 May 2001	UNSCR 1298	UN
Afghanistan (Taliban)	19 Dec 2000	--	UNSCR 1267	UN

# Data: Conflicts



## Countries and periods covered

<b>Country</b>	<b>First event</b>	<b>Last event</b>
Ethiopia	6 May 1998	15 May 2001
Liberia	15 Oct 1985	11 Aug 2003
Somalia	4 Apr 1988	30 Jan 2004
Sierra Leone	1 Oct 1985	17 May 2000
Rwanda	19 Dec 1988	16 Jul 1994
Sudan	6 Apr 1985	29 Mar 2005
Angola	22 Dec 1988	4 Apr 2002
Yugoslavia	9 Oct 1988	17 Mar 2004

## Conflicts (cont'd)



Lexis-Nexis academic:  
Newswires, All available wire reports.  
Terms=country name AND (column) in  
Headline, Lead Paragraph, Terms

### Event selection – Sierra Leone

Date	Type of Event	Description	Conflict Intensity	Lexis-Nexis	t+2	t+1	t=Event	t-1	t-2	t-3	t-4	Unexpected?
05/25/1997	Coup	General Koroma deposes President Kabbah in a military coup. Kabbah flees to Guinea.	+	Coup	47	44	45	0	0	0	0	Yes
10/08/1997	UN Embargo	UN places oil and arms embargo on Sierra Leone	-	Embargo	2	4	9	2	3	1	0	
03/10/1998	Truce	The elected president of Sierra Leone, Kabbah, returns home.	-	President	9	12	45	13	3	5	2	Yes
01/06/1999	Coup Attempt	Unsuccessful coup attempt by Revolutionary United Front	+	Coup	21	31	25	8	3	0	2	Yes
01/08/1999	Major Battle	Rebels besiege and capture Freetown. Over 4,000 dead.	+	Coup	14	12	21	31	25	8	3	No
05/17/2000	Leader Captured	Rebel leader Foday Sankoh captured. Capture was unanticipated: passerby spotted Sankoh near the house he had been staying in.	-	Sankoh	15	21	62	9	7	7	10	Yes

**Appendix Table 1. List of Events Occurring During or Outside The Embargo**

Country	Date Event	Emb.	Event Description	Incr.	Lexis-Nexis Hits					
					t+1	t	t-1	t-2	t-3	t-4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Ethiopia	02/06/1999	0	Fighting renews after a several month lull; heavy casualties	+	46	80	29	18	17	13
Ethiopia	05/12/2000	0	Ethiopia launches major offensive against Eritrean positions	+	37	80	24	16	28	19
Ethiopia	06/18/2000	1	Ethiopia halted its advances and both sides signed a cease fire	-	55	54	14	39	39	43
Ethiopia	12/12/2000	1	Ethiopia and Eritrea sign a treaty formally ending their 2 year war	-	30	41	13	19	7	37
Liberia	04/29/1996	1	fighting resumes, Liberia's head of state, Wilton Sankawulo, and Charles Taylor fled	+	54	19	2	1	10	8
Liberia	09/19/1998	1	Fighting erupts in Monrovia between government forces and partisans of former warl	+	23	16	4	7	3	3
Liberia	08/10/1999	1	Liberian president declares emergency. Fighting rages between gov tropps and force	+	24	12	6	13	0	1
Liberia	06/05/2003	1	LURD rebels launch attack on Monrovia, then withdraw. 300-400 people die and othe	+	47	32	62	28	13	7
Liberia	08/11/2003	1	Charles Taylor resigns, paving the way for ECOWAS peacekeeping mission	-	144	219	54	45	75	141
Somalia	10/03/1993	1	Black Hawk Down Incident. 18 US troops killed and leads immediately to increased t	+	158	105	64	9	23	27
Somalia	08/01/1996	1	Aidid dies, a Somali politician and the leader of the Habr Gidr clan, who hindered inte	-	56	4	4	5	7	6
Sierra Leor	04/29/1992	0	Captain Valentine Strasser stages a coup and removes President Momoh from powe	+	11	15	1	2	0	0
Sierra Leor	02/01/1996	0	Elections organized by the military junta give victory to the Sierra Leone People's Par	-	15	32	15	9	9	3
Sierra Leor	05/25/1997	0	Major General Johnny Paul Koroma deposes President Kabbah in a military coup, su	+	49	51	2	5	1	4
Sierra Leor	03/10/1998	1	The elected president of Sierra Leone, Ahmad Tejan Kabbah, has returned home - te	-	21	59	23	10	17	10
Sierra Leor	01/06/1999	1	Unsuccessful coup attempt by Revolutionary United Front	+	80	92	20	11	17	7
Sierra Leor	05/18/1999	1	Tentative ceasefire between government forces and RUF	-	23	20	8	4	10	16
Sierra Leor	05/17/2000	1	Rebel leader Foday Sankoh captured. His capture came nine days after he had disaj	-	84	131	68	77	35	38
Rwanda	10/21/1993	0	Burundi President Melchior Ndadaye executed by his captors after a coup	+	15	18	1	1	1	0
Rwanda	04/06/1994	0	the airplane carrying President Habyarimana was shot down as it prepared to land at	+	77	27	4	0	2	0
Rwanda	07/04/1994	1	RPF capture Kigali	-	59	60	31	31	43	37
Sudan	04/06/1985	0	Commander-in-Chief of the people's armed forces of sudan Abdel Rahman Mohame	+	14	31	11	10	9	10
Sudan	06/30/1989	0	National Salvation Revolution takes over in military coup.	+	20	22	1	0	1	4
Sudan	12/13/1999	1	President Bashir dissolves the National Assembly and declares a state of emergency	+	35	49	15	7	13	15
Sudan	07/20/2002	0	After talks in Kenya, government and SPLA sign Machakos Protocol on ending 19-ye	-	29	34	9	17	21	15
Angola	12/22/1988	0	Angola, Cuba and South Africa reach agreement. South Africa agrees to withdraw tr	-	24	40	17	13	14	1
Angola	12/14/1998	1	UNITA attacks town of Cuito.	+	24	32	15	10	19	23
Angola	09/28/1999	1	Voice of America: top UNITA general and 2,000 rebels surrendered in Bailundo.	-	15	28	14	7	6	10
Angola	02/22/2002	1	Jonas Savimbi was killed on Feb. 22 by soldiers of the Angolan army	-	62	47	12	10	14	23
Yugoslavia	06/25/1991	0	Croatia and Slovenia proclaim independence.	+	56	38	23	7	18	12
Yugoslavia	01/15/1999	1	Serbian massacre of 45 Kosovars in Racak immediately broadcast to the world	+	65	55	28	56	37	53
Yugoslavia	03/30/2001	1	Milošević arrested on charges of abuse of power and corruption	-	248	252	358	196	41	72
Yugoslavia	03/12/2003	0	The prime minister of Serbia, Zoran Djindjic is assassinated.	+	78	109	15	11	9	17
Yugoslavia	03/17/2004	0	Mitrovica, in Kosovo, experiences the worst ethnic violence in the regions since the 1+	+	103	51	15	14	10	13

**Notes.** Events occurring during embargo or outside the embargo used in the paper. Column 1 indicates the country, Column 2 the date of the event, Column 3 whether the event is under embargo. Column 5 indicates whether the event is predicted to increase or decrease the intensity of the war. Columns 6 through 11 refer to the number of Lexis-Nexis hits in newswire searches using the country name on the event date plus n.

# Data: Companies



## Criteria for inclusion

1. Traded on a stock market
2. Belong to at least one of the following groups:
  - (a) Datastream → SIC code in arms production  
(3482-3484, 3489, 3761, 3764, 3769, 3795, 2892)
  - (b) NISAT list of Small Arm Producers



Final sample:  
97 companies



## Companies (cont'd)

### “WESTERN” Portfolio

Market	No. of companies
US	31
Japan	11
France	9
Australia	5
Germany	5
UK	4
Canada	2
Norway	2
Switzerland	2
Belgium	1
Greece	1
Spain	1
Sweden	1
	75

### “NON-WESTERN” Portfolio

Market	No. of companies
China	5
South Africa	5
Brazil	3
Czech Rep	2
Malaysia	2
South Korea	2
Chile	1
India	1
Peru	1
	22

## Stock Returns



- Stock returns from Datastream-Worldscope matched data
- Identify weapon-producing companies using most recent SIC codes
- Coverage doubles after 1996
- Trim top and bottom 5/10,000 of returns to avoid extreme outliers

# Conflict events and company value



## Imposition of embargo

- Effect = 0 for companies that engage in **no** trading
- Effect < 0 for companies that engage in **legal** trading
- Possibly effect > 0 for companies that will engage in **illegal** trading

# Conflict events and company value



## Increase in conflict during embargo

- Effect = 0 for companies engaging in **no** trading
- Effect = 0 (or < 0) for companies previously engaged in **legal** trading
  - [*End of war -and of embargo- is postponed*]
- Effect > 0 for companies engaging in **illegal** trading
  - [*Longer war means higher sales*]

# Empirical strategy



Part 1: Event study to show an example

- Each company and event examined in isolation

Part 2: Regression analysis

- Pool all companies and events

# Event Study



*How does the value of arms producing companies respond to conflict episodes before & during embargoes?*

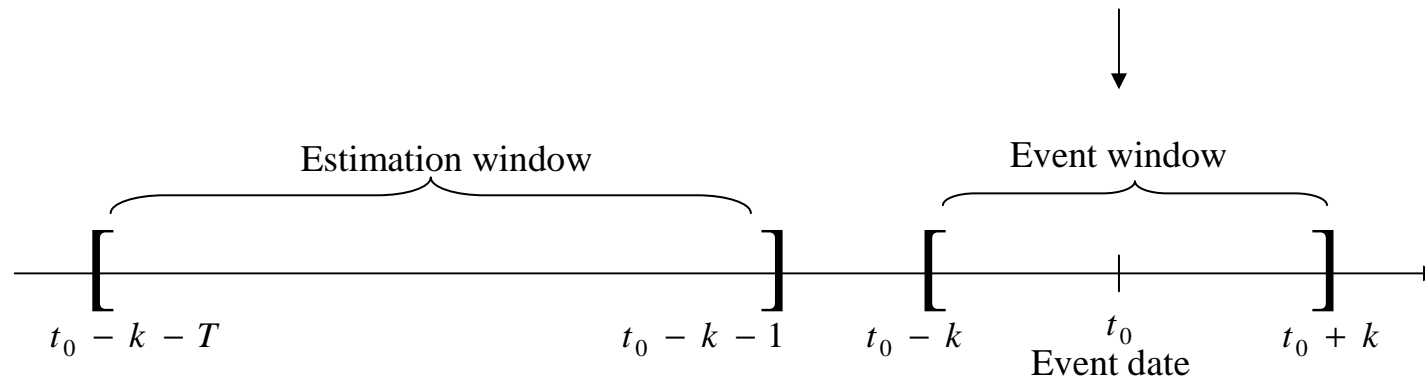
## **Methodology**

Market model

$$r_t = \alpha + \beta r_t^M + e_t$$

Goal: estimate relationship b/w “abnormal return”  $e_t$  and conflict event.

## Event study (cont'd)



- Estimate market model in estimation window

$$\longrightarrow \hat{\alpha}, \hat{\beta}$$

- Predict  $e_t$  in event window

$$e_t = r_t - \hat{\alpha} - \hat{\beta}r_t^M$$

- Cumulative abnormal return:

$$CAR_t = \sum_{j=t_0-k}^t e_j$$

## Event study (cont'd)



### *Parameters choice*

Estimation window: 100 trading days

Event windows:  $(-0,+0)$ ;  $(-1,+1)$ ;  $(-3,-3)$

### *Evidence of effect*

A. Visual inspection (evolution of CAR over time)

B. Formal test of  $H_0: CAR=0$

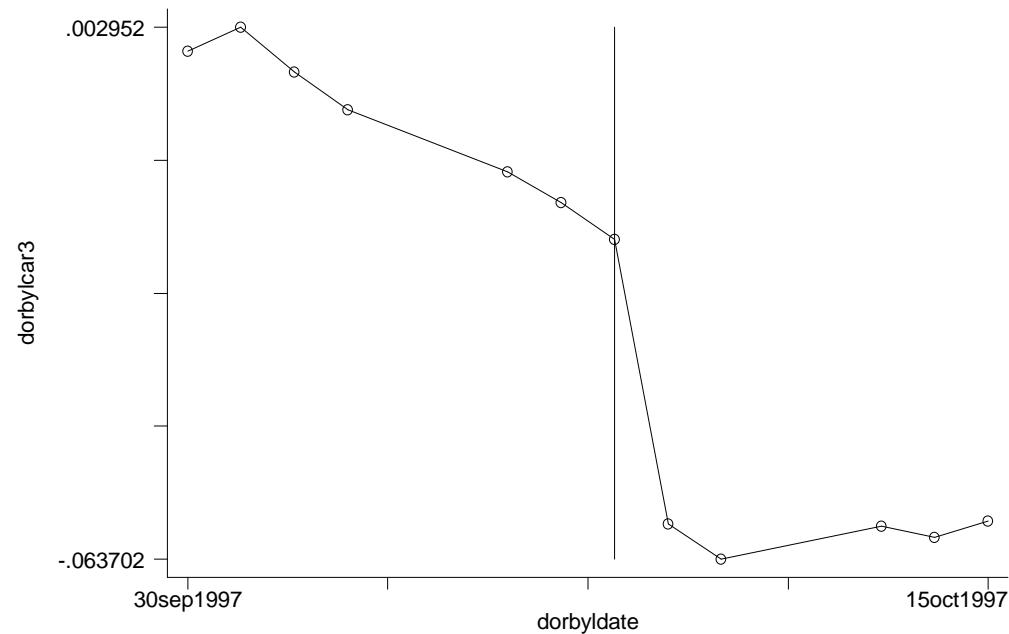
- t test

- (- nonparametric rank & sign tests)



# Example – Sierra Leone

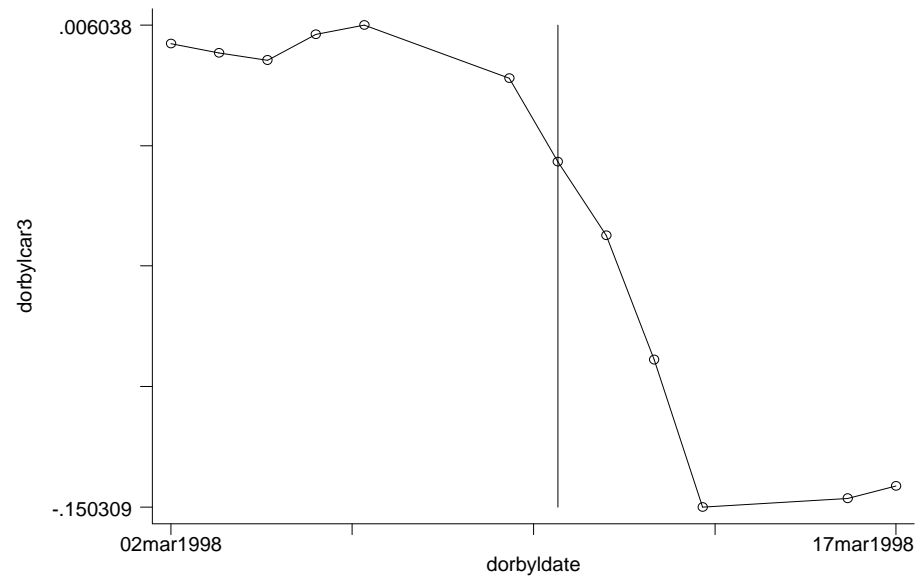
*8 Oct 1997: UN embargo imposed*



Time profile of CAR of a South-African company in the 10 days around event

## Example- Sierra Leone (cont'd)

10 Mar 1998: Elected President Kabbah returns from exile



CAR of the *same* South-African company

# Large sample analysis: tests

country	eventtype	increase	ev_date	ev_wind	Mitsubishi	anhuileim	asahiseiki	daicel	daikin	electroos	firsttech	hanwha	hosoya
(Note: ev_window = 1 if CAR=0 is rejected against CAR>0 at 10%level, 2 at 5% level, 3 at 1%level)													
(Note: ev_window = -1 if CAR=0 is rejected against CAR<0 at 10%level, -2 at 5% level, -3 at 1%level)													
(Note: ev_window = 0 if CAR=0 not rejected; empty cell means "missing data")													
Sierra Leone	Coup	+	30-apr-92 (-0,+0)	0									0
Sierra Leone	Coup	+	30-apr-92 (-1,+1)	0									0
Sierra Leone	Coup	+	30-apr-92 (-5,+5)	0									0
Sierra Leone	Elections	-	02-feb-96 (-0,+0)	0			3	0	0	0	-3	0	0
Sierra Leone	Elections	-	02-feb-96 (-1,+1)	3			3	0	1	0	-3	0	0
Sierra Leone	Elections	-	02-feb-96 (-5,+5)	3			3	0	1	0	-2	0	-3
Sierra Leone	Coup	+	26may1997 (-0,+0)	1			0	0	0	0	0	0	0
Sierra Leone	Coup	+	26may1997 (-1,+1)	3			0	0	0	0	0	0	0
Sierra Leone	Coup	+	26may1997 (-5,+5)	0			0	0	0	0	-2	0	0
Sierra Leone	UN Embargo	-	09oct1997 (-0,+0)	0			0	0	0	0	0	0	0
Sierra Leone	UN Embargo	-	09oct1997 (-1,+1)	0			0	0	0	0	0	0	0
Sierra Leone	UN Embargo	-	09oct1997 (-5,+5)	0			0	0	0	0	0	0	0
Sierra Leone	Return to power	-	11-mar-98 (-0,+0)	0			0	0	0	0	0	0	0
Sierra Leone	Return to power	-	11-mar-98 (-1,+1)	0			0	0	0	0	0	0	0
Sierra Leone	Return to power	-	11-mar-98 (-5,+5)	0			0	0	0	0	2	0	0
Sierra Leone	UN Embargo	+	08jun1998 (-0,+0)	0			0	0	0	0	-2	0	0
Sierra Leone	UN Embargo	+	08jun1998 (-1,+1)	0			0	0	-1	0	-2	0	0
Sierra Leone	UN Embargo	+	08jun1998 (-5,+5)	0			0	0	0	0	0	0	0
Sierra Leone	EU Embargo	-	30jun1998 (-0,+0)	0			0	0	0	0	-2	0	0
Sierra Leone	EU Embargo	-	30jun1998 (-1,+1)	0			0	0	0	0	-2	0	0
Sierra Leone	EU Embargo	-	30jun1998 (-5,+5)	0			0	0	0	0	-1	-1	0
Sierra Leone	Coup Attempt	+	07jan1999 (-0,+0)	0			0	0	0	0	0	-1	0
Sierra Leone	Coup Attempt	+	07jan1999 (-1,+1)	0			0	0	0	0	0	0	0
Sierra Leone	Coup Attempt	+	07jan1999 (-5,+5)	0			0	0	0	0	0	0	0
Sierra Leone	Ceasefire	-	19may1999 (-0,+0)	0			0	0	0	0	0	0	0
Sierra Leone	Ceasefire	-	19may1999 (-1,+1)	0			0	0	0	0	-1	-1	-2
Sierra Leone	Ceasefire	-	19may1999 (-5,+5)	0			0	0	0	0	0	0	-1
Sierra Leone	Leader Captured	-	18may2000 (-0,+0)	0			0	0	0	0	0	2	3
Sierra Leone	Leader Captured	-	18may2000 (-1,+1)	1			0	0	0	0	0	0	2
Sierra Leone	Leader Captured	-	18may2000 (-5,+5)	0			0	0	0	0	0	0	3
total observations					30	0	27	30	30	0	27	30	21
count of observations where CAR=0 is rejected at any level					5	0	3	0	3	0	11	4	6
proportion of observations rejected at any level (note: gray > .25, light < .10)					0,1666667	#DIV/0!	0,11111111	0	0,1	#DIV/0!	0,40740741	0,13333333	0,28571429

## Large sample analysis: tests (cont'd)

country	eventtype	increase	ev_date	ev_wind	Mitsubishi	anhuileim	asahiseiki	daicel	daikin	electroos	firsttech	hanwha	hosoya
(Note: ev_window = 1 if CAR=0 is rejected against CAR>0 at 10%level, 2 at 5% level, 3 at 1%level)													
(Note: ev_window = -1 if CAR=0 is rejected against CAR<0 at 10%level, -2 at 5% level, -3 at 1%level)													
(Note: ev_window = 0 if CAR=0 not rejected; empty cell means "missing data")													
Yugoslavia	Independence	+	26jun1991	(-0,+0)	0				0	0			0
Yugoslavia	Independence	+	26jun1991	(-1,+1)	0				0	0			0
Yugoslavia	Independence	+	26jun1991	(-5,+5)	0				0	0			0
Yugoslavia	UN Embargo	-	26sep1991	(-0,+0)	0				0	0			0
Yugoslavia	UN Embargo	-	26sep1991	(-1,+1)	0				0	0			0
Yugoslavia	UN Embargo	-	26sep1991	(-5,+5)	0				0	0			0
Yugoslavia	UN Embargo Ends	?	23-nov-95	(-0,+0)	0				0	0			0
Yugoslavia	UN Embargo Ends	?	23-nov-95	(-1,+1)	0				0	0			0
Yugoslavia	UN Embargo Ends	?	23-nov-95	(-5,+5)	0				0	0			0
Yugoslavia	UN Embargo	-	01-apr-98	(-0,+0)	0	0		0	0	-2		0	0
Yugoslavia	UN Embargo	-	01-apr-98	(-1,+1)	0	0		-1	0	0		0	0
Yugoslavia	UN Embargo	-	01-apr-98	(-5,+5)	0	0		0	0	0		0	0
Yugoslavia	Major Battle	+	18jan1999	(-0,+0)	0	0		0	-2	0	1	0	0
Yugoslavia	Major Battle	+	18jan1999	(-1,+1)	0	0		0	-3	0	3	0	0
Yugoslavia	Major Battle	+	18jan1999	(-5,+5)	0	-1		0	-3	0	0	0	0
Yugoslavia	Leader Captured	-	02-apr-01	(-0,+0)	-1	0		0	0	0	-2	0	0
Yugoslavia	Leader Captured	-	02-apr-01	(-1,+1)	0	-2		0	0	0	-2	0	0
Yugoslavia	Leader Captured	-	02-apr-01	(-5,+5)	0	0		1	0	0	0	0	0
Yugoslavia	Assassination	+	13-mar-03	(-0,+0)	0	0		0	0	0	0	0	1
Yugoslavia	Assassination	+	13-mar-03	(-1,+1)	0	0		0	0	2	-1	2	0
Yugoslavia	Assassination	+	13-mar-03	(-5,+5)	0	0		0	0	3	0	0	0
Yugoslavia	Start Fighting	+	18-mar-04	(-0,+0)	0	0		-1	-1	0	2	0	2
Yugoslavia	Start Fighting	+	18-mar-04	(-1,+1)	0	-2		-1	0	0	0	0	0
Yugoslavia	Start Fighting	+	18-mar-04	(-5,+5)	0	0		0	0	0	2	0	0
total observations					24	0	15	24	24	9	15	24	15
count of observations where CAR=0 is rejected at any level					1	0	3	4	5	2	7	2	2
proportion of observations rejected at any level (note: gray > .25, light < 0,04166667 #DIV/0!					0,2	0,16666667	0,20833333	0,20833333	0,22222222	0,46666667	0,08333333	0,13333333	0,13333333

# Regression analysis



## Methodology

Pooled sample of companies and events

$$e_{i,t} = \alpha + \gamma_0 Emb_t + \gamma_1 Emb_t * NW_i + \delta_0 Out_t + \delta_1 Out_t * NW_i + \theta NW_i + \eta_{i,t}$$

where:

$Emb_t = +1$  if event that **increases** conflict occurs at  $t$  **during** embargo

$= 0$  if nothing happens

$= -1$  if event that **decreases** conflict occurs at  $t$  **during** embargo

$Out_t = 1$  if event that **increases** conflict occurs at  $t$  **outside** embargo

...

$NW_i = 1$  if company  $i$  belongs to “Non-Western” sample

## Methodology (contd.)

- Dependent variable  $e_{it}$  is abnormal return, corrected using market model estimated on returns in the previous year
- Robust standard errors, clustered by date  
(Control for any within-day correlation of returns across companies)



**Baseline test of trading.** Coefficient  $\gamma_0$  captures impact of event increasing (decreasing) war, occurring during embargo

Legal (or no) trading:  $\gamma_0 = 0$  or  $< 0$

Illegal trading:  $\gamma_0 > 0$

**Sophisticated test of trading.** Illegal trading more common for non-Western companies

Illegal trading:  $\gamma_1 > 0$

**Table 3. Stock Market Reaction to War Events**

Dep. Var.:	Stock Market Returns (-1,1) relative to Event Abnormal Returns
	(1)
Constant	0 (0.0001)
Event During Embargo (1=Increase War, -1=Decrease)	0 (0.0025)
Event During Embargo* (Non-Western Country)	
Event Not During Embargo (1=Increase War, -1=Decrease)	0.0036 (0.0033)
Event Not During Embargo* (Non-Western Country)	
Non-Western Country	
All arm-producing companies	X
Companies in NISAT List	
Companies in Datastream	
Clustering by Trading Day	X
R <sup>2</sup>	0
N	263952

**Baseline test.**  
 Across all companies,  
 no significant effect of  
 the events inside or  
 outside embargo.

No evidence of  
 illegal trades?

**Table 3. Stock Market Reaction to War Events**

Dep. Var.:	Stock Market Returns (-1,1) relative to Event			
	Abnormal Returns			
	(1)	(2)	(3)	(4)
Constant	0 (0.0001)	0 (0.0001)	0 (0.0002)	0 (0.0001)
Event During Embargo (1=Increase War, -1=Decrease)	0 (0.0025)	-0.0026 (0.0024)	0.0005 (0.0030)	-0.0032 (0.0025)
Event During Embargo* (Non-Western Country)		0.0137 (0.0047)***	0.0107 (0.0062)*	0.0139 (0.0048)***
Event Not During Embargo (1=Increase War, -1=Decrease)	0.0036 (0.0033)	0.0045 (0.0030)	-0.0013 (0.0035)	0.0053 (0.0033)
Event Not During Embargo* (Non-Western Country)		-0.0056 (0.0049)	-0.009 (0.0062)	-0.0066 (0.0059)
Non-Western Country		-0.0005 (0.0003)	0.0004 (0.0004)	-0.0006 (0.0004)*
All arm-producing companies	X	X		X
Companies in NISAT List			X	
Companies in Datastream				X
Clustering by Trading Day	X	X	X	X
R <sup>2</sup>	0	0.0001	0.0002	0.0001
N	263952	263952	51892	236376

Sophisticated test.  
Compare Western  
and Non-Western  
Countries

→ Significant  
difference



**Table 3. Stock Market Reaction to War Events**

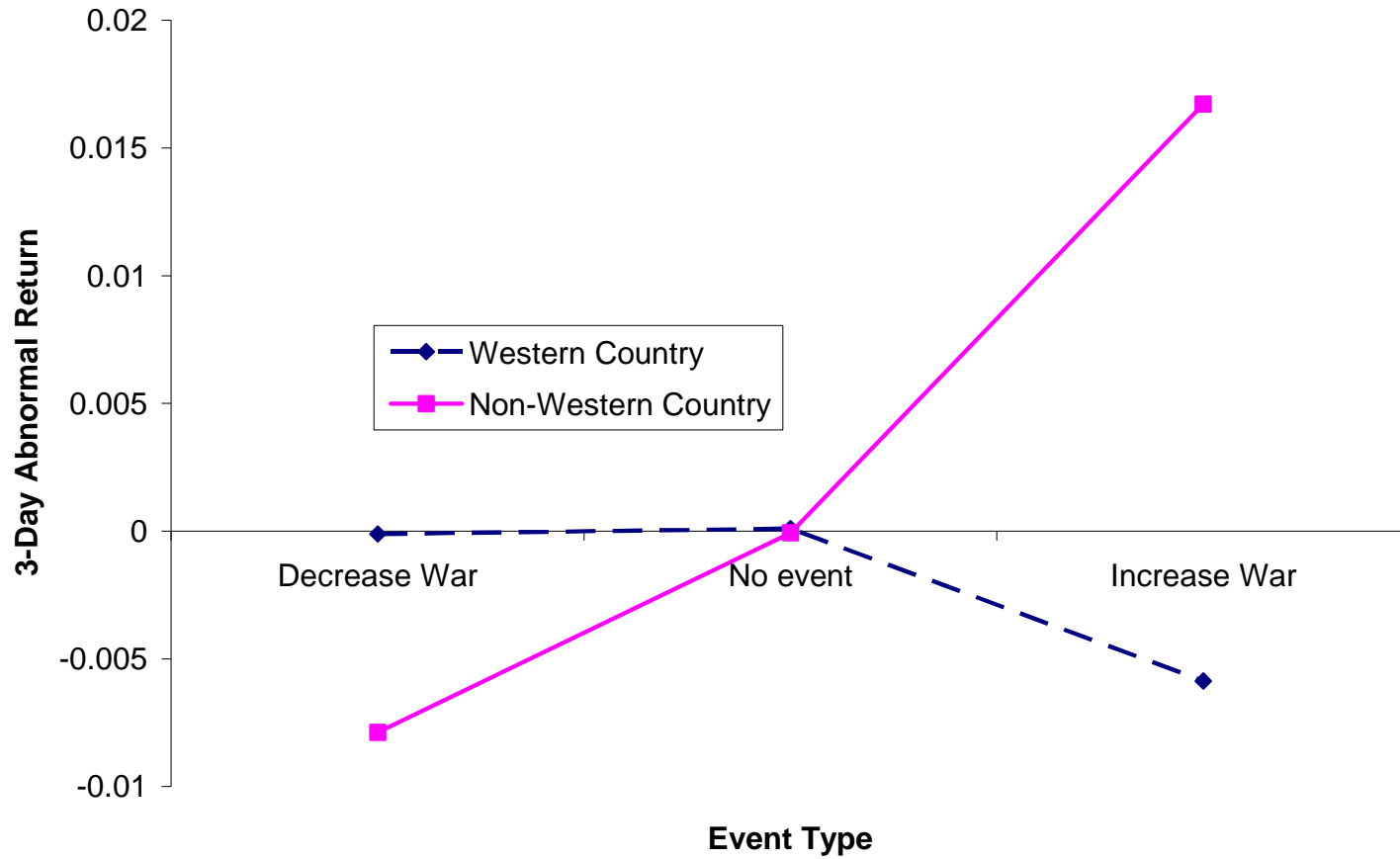
Dep. Var.:	Stock Market Returns (-1,1) relative to Event					
	Abnormal Returns				Raw Ret.	Excess Ret.
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0 (0.0001)	0 (0.0001)	0 (0.0002)	0 (0.0001)	0.002 (0.0002)***	0.0009 (0.0002)***
Event During Embargo (1=Increase War, -1=Decrease)	0 (0.0025)	-0.0026 (0.0024)	0.0005 (0.0030)	-0.0032 (0.0025)	-0.0041 (0.0024)*	-0.0024 (0.0027)
Event During Embargo* (Non-Western Country)		0.0137 (0.0047)***	0.0107 (0.0062)*	0.0139 (0.0048)***	0.0123 (0.0045)***	0.0096 (0.0042)**
Event Not During Embargo (1=Increase War, -1=Decrease)	0.0036 (0.0033)	0.0045 (0.0030)	-0.0013 (0.0035)	0.0053 (0.0033)	0.0085 (0.0062)	-0.0035 (0.0029)
Event Not During Embargo* (Non-Western Country)		-0.0056 (0.0049)	-0.009 (0.0062)	-0.0066 (0.0059)	-0.0041 (0.0041)	-0.0002 (0.0056)
Non-Western Country		-0.0005 (0.0003)	0.0004 (0.0004)	-0.0006 (0.0004)*	0.0003 (0.0003)	0 (0.0003)
All arm-producing companies	X	X		X	X	X
Companies in NISAT List			X			
Companies in Datastream				X		
Clustering by Trading Day	X	X	X	X	X	X
R <sup>2</sup>	0	0.0001	0.0002	0.0001	0.0001	0
N	263952	263952	51892	236376	309914	285904

# Summary I



- In **Western** countries, no evidence of illegal trading (and limited evidence of legal trading)
- In **Non-Western** countries, indicator of illegal trading
  - Increase of war associated with 1.37 percent 3-day abnormal return (relative to Western countries)
  - Decrease of war associated with -1.37 percent return
- Robust to defining portfolio according to **Arms Transparency** Index
- Does effect depend on events *increasing* or *decreasing* war?

**Figure 1. Event Returns by Western/non-Western Country**



Effect is on both sides, and mostly for events that increase war.  
On which day does return occur?

**Table 4a. Timing of Stock Market Reaction**

Dep. Var.: Timing relative to Event:	Abnormal 1-Day Stock Market Return				
	(-2,-2)	(-1,-1)	(0,0)	(1,1)	(2,2)
	(1)	(2)	(3)	(4)	(5)
Event During Embargo (1=Increase War, -1=Decrease)	0 (0.0016)	-0.0004 (0.0009)	-0.0009 (0.0014)	-0.0019 (0.0012)	0.0004 (0.0014)
Event During Embargo* (Non-Western Country)	0.0023 (0.0027)	0.0093 (0.0024)***	0.0019 (0.0028)	0.0034 (0.0021)	-0.0027 (0.0026)
Event Not During Embargo (1=Increase War, -1=Decrease)	-0.0012 (0.0017)	0.0003 (0.0012)	0.001 (0.0020)	0.0025 (0.0010)**	-0.0002 (0.0017)
Event Not During Embargo* (Non-Western Country)	0.0006 (0.0024)	-0.0016 (0.0022)	-0.0015 (0.0037)	-0.0042 (0.0023)*	0.0012 (0.0030)
Non-Western Country	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)
Clustering by Date	X	X	X	X	X
R <sup>2</sup>	0	0.0001	0	0	0
N	263859	263937	264015	264015	264015

## Summary II



- Most of the 3-day return occurs in day -1
- Portion occurring also in day 0 and day 1
- Why day -1?
  - Noise in our coding of the news (Lexis-Nexis)
  - Smart investors anticipate event
  - Date of event for Asian companies shifted ahead by 1 day
- Is finding spurious? **Placebo** specification.  
Check if return responds several days in advance or several days later

**Table 4b. Stock Market Reaction: Placebo Treatments**

Dep. Var.: Timing relative to Event:	Abnormal 3-Day Stock Market Return			
	(-7,-5)	(-4,-2)	(2,4)	(5,7)
	(6)	(7)	(8)	(9)
Event During Embargo (1=Increase War, -1=Decrease)	-0.0022 (0.0023)	0.0039 (0.0023)*	0.0007 (0.0025)	-0.0044 (0.0016)***
Event During Embargo* (Non-Western Country)	-0.0017 (0.0037)	-0.0016 (0.0045)	0.0015 (0.0049)	0.0067 (0.0057)
Event Not During Embargo (1=Increase War, -1=Decrease)	0.0031 (0.0038)	0.0011 (0.0032)	0.0032 (0.0029)	0.0007 (0.0022)
Event Not During Embargo* (Non-Western Country)	-0.0033 (0.0051)	-0.0068 (0.0062)	-0.0026 (0.0070)	-0.0089 (0.0069)
Non-Western Country		-0.0005 (0.0033)	-0.0005 (0.0003)	-0.0005 (0.0003)
Clust			X	X
R <sup>2</sup>			0	0
N	263506	263796	263952	263952

Regression passes placebo test  
No evidence of effect in 3-day period around -6, -3, +3, or +6.

# Magnitude



- How large is effect? Is 1.37 percent too much?

## Back-of-the-envelope calculation

- Consider event like death of Savimbi in Angola → leads to sudden end of civil war
- Without Savimbi's death, war could have lasted another 10 years
- Compute change in value of company selling illegally to Angola

- **Calibration.** Assume discounted company profits

$$\pi_A Q_A \frac{1 - \delta^{10}}{1 - \delta} + \pi_{NA} Q_{NA} \frac{1}{1 - \delta}$$

- $\delta$  is market discount factor  $\approx .95$
- $Q_i$  is quantity of output sold in country  $i$  ( $A$  Angola,  $NA$  Rest of world)
- $\pi_i$  is profit rate per quantity of output sold in country  $i$
- At Savimbi's death, stock return is

$$-\frac{\pi_A Q_A \frac{1 - \delta^{10}}{1 - \delta}}{\pi_A Q_A \frac{1 - \delta^{10}}{1 - \delta} + \pi_{NA} Q_{NA} \frac{1}{1 - \delta}} = -.0137$$



- This implies

$$\frac{Q_A}{Q_{NA}} = \frac{\pi_{NA}}{\pi_A} * \left( \frac{.0137}{1 - .0137} \right) \frac{1}{1 - \delta^{10}} \approx \frac{\pi_{NA}}{\pi_A} * .035$$

- Assuming  $\pi_{NA}/\pi_A = 1$ , this implies that average illegal weapon sale in Angola per company should be about 3.5 percent of total other sales.
- BUT: illegal sales should garner higher profit rate per unit.
  - For  $\pi_{NA}/\pi_A = .5$ , get  $Q_A/Q_{NA} = .017$  (2 percent of sales)
  - For  $\pi_{NA}/\pi_A = .3$ , get  $Q_A/Q_{NA} = .011$  (1 percent of sales)
- Not unreasonable for small non-Western companies

# Concluding remarks



## Main message

- Use investor knowledge to make inferences about illegal company transactions
- Evidence of illegal arms trading during embargo for non-Western companies
- Drawback: Not enough power to identify individual company or war

## Future work

- Construct portfolios for event study analysis
- Use response to conflict events *before* embargo to attempt to identify companies active in those markets
- Missing imports (exports) from trade statistics
- Voting records for UNSC arms resolutions