

Ποσοτικές στρατηγικές επένδυσης  
στις διεθνείς αγορές  
(Khandani & Lo)

# Χρονολογία επεισοδίων Αυγούστου 2007

- Προβλήματα στην αγορά ενυπόθηκου δανεισμού υψηλού κινδύνου (sub-prime) με αντίκτυπο στις αγορές ομολόγων και δανεισμού
- Εβδομάδα 6 Αυγούστου:
  - Μεγάλες απώλειες σε hedge funds **μετοχών** που ακολουθούσαν **ποσοτικές** στρατηγικές **ουδέτερες** προς την κατεύθυνση της αγοράς
  - Στις 7 και 8 Αυγούστου μεγάλες απώλειες ενώ η αγορά δεν κινήθηκε ιδιαίτερα
  - Στις 9 Αυγούστου μεγάλες απώλειες μαζί με 3% πτώση αγοράς
  - Στις 10 Αυγούστου κινήσεις αυτές αντιστράφηκαν σε κάποιο βαθμό
  - Συνολικά χάσαν 5-30% σε εκείνες τις μέρες ακόμα και funds με καλύτερες αποδόσεις στον χώρο
    - π.χ. Renaissance Technologies Corp (αποδόσεις 35% από 1989 έχασε 8.7% Αυγ07)

Index / Sub Strategies	August 2007
Credit Suisse/Tremont Hedge Fund Index	-1.53%
Convertible Arbitrage	-1.08%
Dedicated Short Bias	-1.14%
Emerging Markets	-2.37%
Equity Market Neutral	-0.39%
Event Driven	-1.88%
Distressed	-1.73%
Multi-Strategy	-2.03%
Risk Arbitrage	-0.65%
Fixed Income Arbitrage	-0.87%
Global Macro	-0.62%
Long/Short Equity	-1.38%
Managed Futures	-4.61%
Multi-Strategy	-1.40%

Table 9: CS/Tremont hedge-fund index returns for the month of August 2007. Source: [www.hedgeindex.com](http://www.hedgeindex.com).

παράδειγμα ποσοτικής στρατηγικής ουδέτερης προς την αγορά:

Βάρος ανά μετοχή  $i$ :

$$\omega_{it} = -\frac{1}{N}(R_{it-k} - R_{mt-k}) \quad , \quad R_{mt-k} \equiv \frac{1}{N} \sum_{i=1}^N R_{it-k}$$

$k=1$  μέρα

“αντιθετική στρατηγική” που προσφέρει ρευστότητα

Αποδόσεις μετρώνται ως:

$$I_t \equiv \frac{1}{2} \sum_{i=1}^N |\omega_{it}| \quad , \quad R_{pt} \equiv \frac{\sum_{i=1}^N \omega_{it} R_{it}}{I_t}$$

Με μόχλευση  $\theta : 1$

$$L_{pt}(\theta) \equiv \frac{(\theta/2) \sum_{i=1}^N \omega_{it} R_{it}}{I_t}$$

# Αποδόσεις ποσοτικής στρατηγικής Lehman-Lo-MacKinlay

Year	Market Capitalization Deciles										All
	Smallest	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Largest	
<b>Average Daily Returns</b>											
1995	3.57%	2.75%	1.94%	1.62%	1.07%	0.61%	0.21%	-0.01%	-0.02%	0.04%	1.38%
1996	3.58%	2.47%	1.82%	1.34%	0.84%	0.52%	0.19%	-0.11%	-0.04%	0.02%	1.17%
1997	2.83%	1.94%	1.34%	1.02%	0.62%	0.28%	0.04%	-0.12%	0.06%	0.14%	0.88%
1998	2.38%	1.45%	1.11%	0.62%	0.29%	0.03%	-0.04%	-0.12%	0.03%	0.10%	0.57%
1999	2.56%	1.41%	0.82%	0.38%	-0.01%	-0.11%	-0.21%	-0.35%	-0.01%	0.06%	0.44%
2000	2.58%	1.59%	0.92%	0.14%	0.03%	-0.02%	-0.14%	0.16%	0.00%	0.03%	0.44%
2001	2.15%	1.25%	0.57%	0.24%	-0.01%	0.06%	0.13%	-0.10%	-0.11%	-0.11%	0.31%
2002	1.67%	0.85%	0.53%	0.29%	0.28%	0.26%	0.28%	0.20%	0.11%	0.09%	0.45%
2003	1.00%	0.26%	-0.07%	0.04%	0.11%	0.20%	0.18%	0.15%	0.04%	0.05%	0.21%
2004	1.17%	0.48%	0.31%	0.38%	0.25%	0.29%	0.22%	0.15%	0.05%	-0.01%	0.37%
2005	1.05%	0.39%	0.13%	0.11%	0.09%	0.11%	0.05%	0.08%	0.01%	0.02%	0.26%
2006	0.86%	0.26%	0.11%	0.06%	0.05%	-0.02%	-0.02%	0.05%	0.06%	0.00%	0.15%
2007	0.57%	0.09%	0.08%	0.18%	0.16%	-0.08%	0.04%	-0.04%	0.00%	-0.04%	0.13%
<b>Standard Deviation of Daily Returns</b>											
1995	0.92%	0.88%	0.81%	0.82%	0.78%	0.77%	0.73%	0.67%	0.63%	0.65%	0.40%
1996	1.07%	1.00%	0.79%	0.81%	0.88%	0.84%	0.90%	0.90%	0.83%	0.73%	0.48%
1997	1.04%	0.98%	0.96%	0.96%	1.12%	1.00%	0.91%	0.99%	0.98%	0.77%	0.68%
1998	1.59%	1.67%	1.23%	1.22%	1.57%	1.25%	1.29%	1.43%	1.08%	1.00%	0.84%
1999	1.66%	1.82%	1.44%	1.44%	1.79%	1.57%	1.71%	1.70%	1.57%	1.07%	1.02%
2000	1.57%	1.69%	2.06%	1.89%	1.76%	2.15%	2.18%	2.29%	2.44%	2.56%	1.68%
2001	1.33%	1.26%	1.46%	1.62%	1.65%	1.64%	1.83%	1.91%	2.28%	2.29%	1.43%
2002	1.17%	0.89%	1.14%	1.07%	1.25%	1.11%	1.30%	1.42%	1.50%	1.50%	0.98%
2003	1.11%	0.81%	0.95%	0.89%	0.86%	0.81%	0.77%	0.76%	0.75%	0.56%	0.54%
2004	1.35%	1.01%	0.87%	0.76%	0.76%	0.78%	0.80%	0.74%	0.69%	0.57%	0.53%
2005	1.35%	0.80%	0.89%	0.70%	0.77%	0.77%	0.65%	0.73%	0.57%	0.56%	0.46%
2006	1.07%	0.90%	0.83%	0.84%	0.70%	1.07%	0.68%	0.68%	0.64%	0.61%	0.52%
2007	0.96%	1.02%	1.00%	0.99%	1.06%	1.44%	1.00%	0.87%	0.67%	0.56%	0.72%
<b>Annualized Sharpe Ratio (0% Riskfree Rate)</b>											
1995	61.27	49.20	37.79	31.26	21.49	12.68	4.62	-0.22	-0.54	0.87	53.87
1996	53.08	39.12	36.27	26.10	15.17	9.85	3.38	-1.89	-0.69	0.36	38.26
1997	43.15	31.19	22.00	16.66	8.67	4.45	0.74	-1.88	0.95	2.79	20.46
1998	23.61	13.78	14.22	8.09	2.92	0.39	-0.54	-1.32	0.43	1.58	10.62
1999	24.32	12.25	9.05	4.22	-0.11	-1.08	-1.93	-3.23	-0.09	0.82	6.81
2000	25.96	14.91	7.04	1.18	0.31	-0.18	-1.04	1.14	0.01	0.21	4.17
2001	25.56	15.68	6.15	2.30	-0.05	0.57	1.09	-0.79	-0.79	-0.73	3.46
2002	22.54	15.10	7.30	4.28	3.57	3.68	3.38	2.24	1.13	0.98	7.25
2003	14.32	5.19	-1.11	0.63	1.94	3.91	3.64	3.09	0.89	1.33	5.96
2004	13.76	7.55	5.60	7.96	5.11	5.90	4.27	3.20	1.12	-0.33	11.07
2005	12.33	7.72	2.26	2.42	1.95	2.29	1.31	1.74	0.36	0.62	8.85
2006	12.72	4.49	2.08	1.18	1.14	-0.26	-0.56	1.08	1.60	-0.03	4.47
2007	9.40	1.45	1.33	2.93	2.40	-0.84	0.69	-0.74	-0.05	-1.03	2.79

Table 2: Year-by-year average daily returns, standard deviations of daily returns, and annualized Sharpe ratios ( $\sqrt{250} \times (\text{average daily return}/\text{standard deviation})$ ) of Lo and MacKinlay's (1990) contrarian trading strategy applied to all U.S. common stocks (CRSP share codes 10 and 11) with share prices above \$5 and less than \$2,000, and market-capitalization deciles, from January 3, 1995 to August 31, 2007.

Average Daily Returns of Contrarian Trading Strategy By Year and Market-Capitalization Deciles, 1995 to 2007

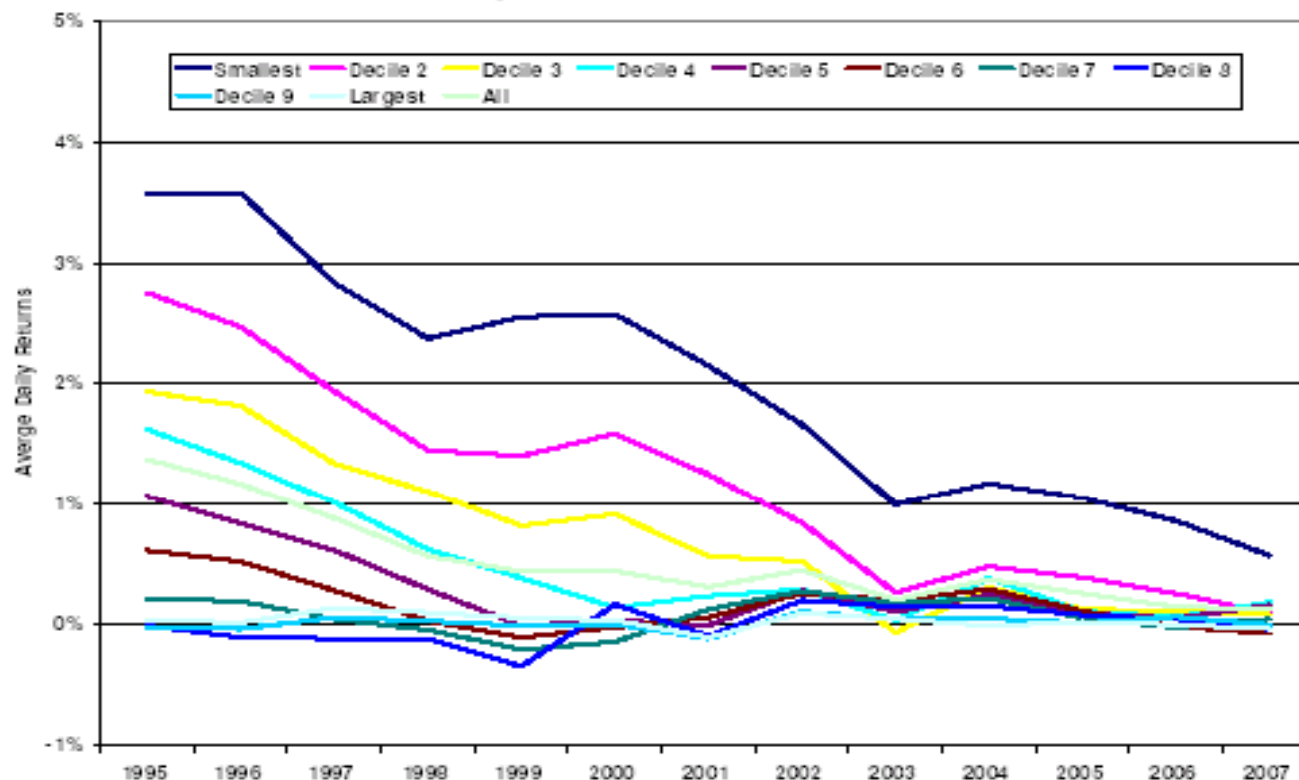


Figure 1: Year-by-year average daily returns of Lo and MacKinlay's (1990) contrarian trading strategy applied to all U.S. common stocks (CRSP share codes 10 and 11) with share prices above \$5 and less than \$2,000, and market-capitalization deciles, from January 3, 1995 to August 31, 2007.

Date	Deciles by Market Capitalization										All
	Smallest	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Largest	
7/30/2007	-0.07%	0.02%	1.96%	-0.36%	0.07%	0.23%	0.26%	0.38%	0.51%	0.18%	0.44%
7/31/2007	0.19%	1.10%	0.28%	0.55%	-0.63%	0.02%	-0.80%	0.49%	-0.31%	0.06%	0.36%
8/1/2007	1.53%	0.45%	-1.39%	0.35%	0.95%	-0.88%	-0.71%	-0.63%	-2.02%	-0.22%	0.11%
8/2/2007	0.88%	-0.76%	-0.12%	-0.67%	-0.94%	-2.70%	2.16%	1.53%	-0.74%	-0.19%	-0.30%
8/3/2007	-0.95%	-0.62%	-0.78%	0.06%	0.88%	0.01%	-0.62%	-1.09%	-0.57%	-0.68%	-0.02%
8/6/2007	-0.83%	-1.77%	-0.39%	-1.03%	1.37%	-1.37%	-1.19%	-0.72%	0.27%	0.77%	0.50%
8/7/2007	0.75%	0.26%	-1.64%	-2.91%	-1.50%	-0.70%	0.36%	-1.02%	-1.72%	-0.67%	-1.16%
8/8/2007	0.88%	-1.33%	-2.59%	-3.65%	-4.27%	-2.16%	-2.23%	-3.46%	-1.26%	-1.48%	-2.83%
8/9/2007	0.91%	-1.86%	-3.87%	-2.77%	-3.18%	-3.95%	-3.27%	-4.33%	-2.58%	-1.31%	-2.86%
8/10/2007	-0.33%	3.65%	6.08%	7.90%	8.77%	7.67%	7.52%	6.70%	4.68%	2.39%	5.92%
8/13/2007	1.36%	-0.31%	-0.63%	-1.07%	-1.55%	-0.22%	-1.29%	-2.01%	-2.14%	-1.25%	-0.76%
8/14/2007	1.16%	0.91%	-0.26%	0.34%	0.56%	-0.28%	0.69%	-0.29%	0.16%	0.17%	0.08%
8/15/2007	0.88%	1.19%	-0.61%	-0.58%	-0.17%	-0.97%	-0.24%	-1.34%	-0.57%	-1.18%	-0.38%
8/16/2007	-1.26%	-0.54%	0.15%	-0.59%	-0.60%	-0.99%	-1.73%	-1.27%	0.27%	-1.83%	-0.81%
8/17/2007	3.57%	2.49%	0.10%	1.26%	1.33%	-0.52%	0.12%	-0.39%	0.31%	0.11%	0.38%
8/20/2007	3.75%	1.75%	0.35%	1.35%	0.51%	0.44%	1.22%	0.56%	0.39%	1.17%	1.14%
8/21/2007	1.24%	0.11%	0.01%	-0.45%	0.02%	-0.63%	-0.08%	-0.05%	0.19%	0.11%	0.06%
8/22/2007	-0.85%	-0.31%	-0.52%	-0.51%	-0.17%	-0.83%	-0.18%	-0.56%	0.39%	0.09%	-0.38%
8/23/2007	-0.03%	0.70%	0.70%	-0.16%	0.38%	1.04%	0.26%	-0.33%	0.32%	0.31%	0.33%
8/24/2007	0.62%	-0.28%	-0.07%	0.23%	0.92%	-0.06%	-0.07%	0.09%	-0.35%	0.61%	0.43%
8/27/2007	1.10%	0.70%	0.11%	0.20%	1.25%	-0.16%	0.39%	0.71%	0.71%	0.03%	0.75%
8/28/2007	0.41%	0.32%	0.08%	-0.61%	-0.64%	-0.50%	-0.33%	-0.44%	-0.47%	0.25%	-0.76%
8/29/2007	1.45%	0.08%	1.27%	2.08%	1.94%	-0.53%	1.42%	1.60%	0.91%	0.98%	1.76%
8/30/2007	1.07%	0.04%	0.62%	0.40%	0.89%	0.10%	-0.03%	-0.04%	0.12%	-0.05%	0.50%
8/31/2007	1.69%	0.97%	0.95%	-0.55%	0.05%	0.52%	-0.08%	-0.67%	0.01%	0.14%	0.36%

Table 3: Daily returns of Lo and MacKinlay's (1990) contrarian trading strategy applied to all U.S. common stocks (CRSP share codes 10 and 11) with share prices above \$5 and less than \$2,000, and market-capitalization deciles, from Monday July 30, 2007 to Friday August 31, 2007.

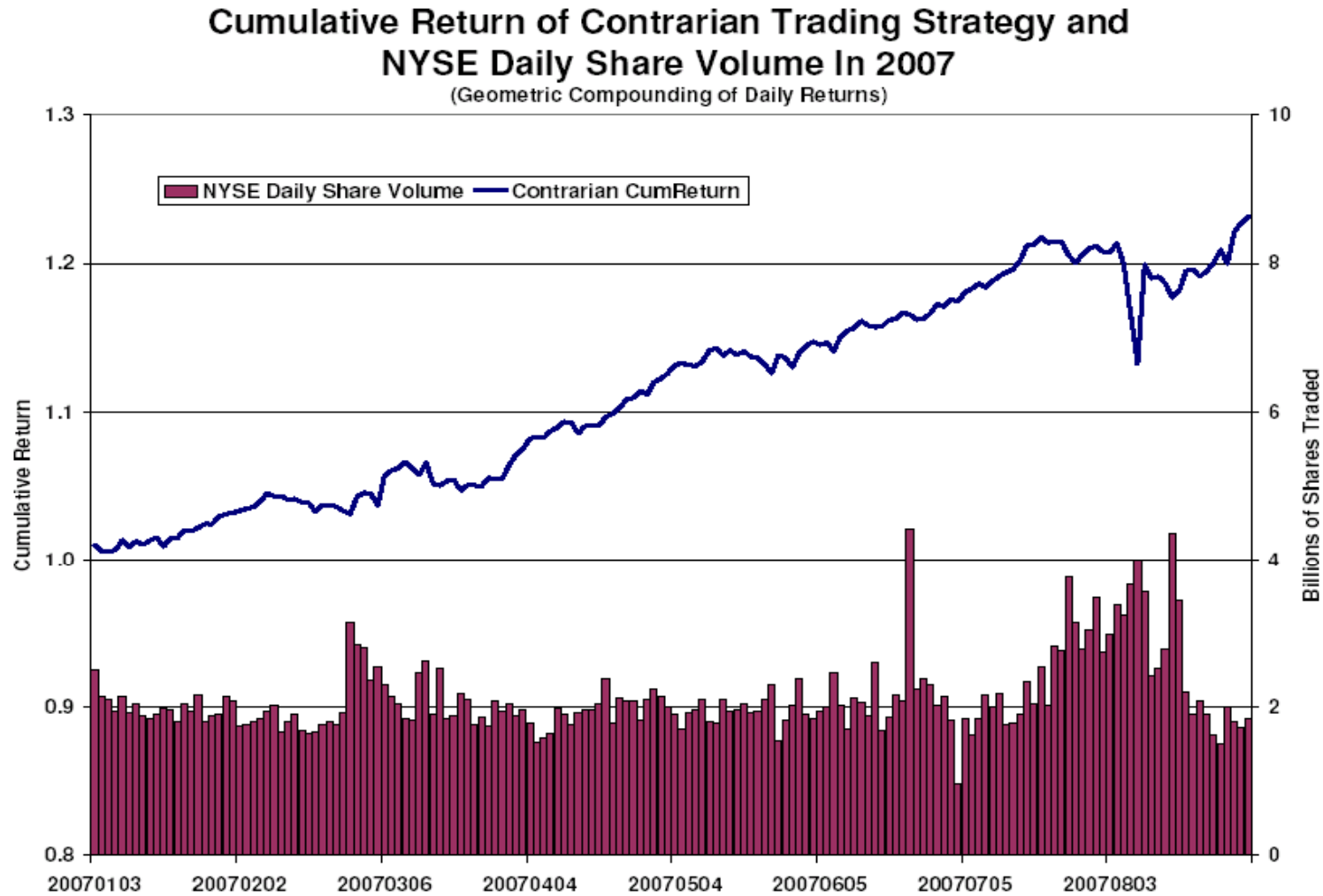


Figure 2: Cumulative return of the contrarian trading strategy from January 3 to August 31, 2007, and the NYSE daily share volume during this same period.



Date	S&P 500	S&P Small Cap 600	MSCI Emerging Markets	MSCI World ex. US	Lehman Aggregate US Gov. Index	Lehman US Universal Corp. High-Yield Index	Goldman Sachs Commodity Index	Trade Weighted USD Index	CBOE Volatility Index (VIX) Change
7/30/2007	1.03%	0.94%	0.87%	0.14%	-0.04%	0.18%	0.11%	-0.12%	-3.30
7/31/2007	-1.26%	-0.88%	1.67%	1.36%	0.17%	0.61%	1.18%	-0.10%	2.65
8/1/2007	0.73%	0.19%	-3.42%	-1.70%	0.04%	-0.15%	-1.34%	0.13%	0.15
8/2/2007	0.46%	0.98%	0.61%	0.62%	0.04%	0.53%	0.00%	-0.20%	-2.45
8/3/2007	-2.65%	-3.48%	-0.05%	-0.37%	0.29%	0.08%	-1.10%	-0.66%	3.94
8/6/2007	2.42%	1.35%	-1.99%	-0.57%	-0.14%	-0.29%	-2.76%	0.10%	-2.56
8/7/2007	0.62%	0.71%	0.45%	0.56%	-0.04%	0.38%	0.34%	0.28%	-1.04
8/8/2007	1.44%	1.52%	2.83%	1.88%	-0.48%	0.84%	-0.20%	-0.17%	-0.11
8/9/2007	-2.95%	-1.38%	-1.28%	-1.52%	0.31%	-0.07%	-0.37%	0.54%	5.03
8/10/2007	0.04%	1.01%	-3.30%	-2.85%	0.07%	-0.29%	-0.03%	-0.12%	1.82
8/13/2007	-0.03%	-0.84%	1.01%	1.08%	0.04%	0.34%	0.27%	0.46%	-1.73
8/14/2007	-1.81%	-1.87%	-1.42%	-1.10%	0.23%	-0.10%	0.35%	0.54%	1.11
8/15/2007	-1.36%	-1.45%	-2.39%	-1.52%	0.15%	-0.56%	0.80%	0.41%	2.99
8/16/2007	0.33%	1.70%	-5.63%	-2.91%	0.58%	-0.59%	-3.01%	-0.11%	0.16
8/17/2007	2.46%	2.30%	0.12%	0.96%	-0.28%	0.24%	1.49%	-0.37%	-0.84
8/20/2007	-0.03%	0.30%	3.78%	1.23%	0.23%	0.24%	-1.65%	-0.03%	-3.66
8/21/2007	0.11%	0.21%	-0.18%	0.61%	0.24%	0.19%	-1.14%	0.11%	-1.08
8/22/2007	1.18%	1.19%	2.58%	1.27%	-0.16%	0.37%	0.04%	-0.30%	-2.36
8/23/2007	-0.11%	-1.16%	1.76%	1.16%	-0.01%	0.22%	0.96%	-0.13%	-0.27
8/24/2007	1.16%	1.44%	0.44%	0.51%	-0.10%	0.04%	1.10%	-0.59%	-1.90
8/27/2007	-0.85%	-1.07%	1.90%	0.29%	0.23%	0.17%	0.28%	0.09%	2.00
8/28/2007	-2.34%	-2.70%	-0.85%	-1.26%	0.34%	-0.07%	-0.17%	0.02%	3.58
8/29/2007	2.22%	2.28%	-0.23%	0.04%	-0.09%	-0.06%	1.40%	-0.07%	-2.49
8/30/2007	-0.41%	-0.38%	1.31%	0.80%	0.29%	0.06%	0.15%	0.12%	1.25
8/31/2007	1.12%	1.28%	2.39%	1.58%	-0.16%	0.01%	0.48%	0.00%	-1.68

Table 4: Daily returns of various market indexes from Monday July 30, 2007 to Friday August 31, 2007. With the exception of the Goldman Sachs Commodities Index and the Trade Weighted USD Index, which are obtained from the Global Financial Database, all other data series are obtained from Datastream. In all cases the total returns index is used, which capture the effects of any coupons and/or dividends that would accrue to an investor in the underlying assets of these indexes.

Date	Deciles by Market Capitalization										All
	Smallest	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Largest	
8/3/1998	3.35%	1.75%	1.68%	0.15%	3.25%	-0.33%	0.40%	0.06%	0.62%	0.16%	1.01%
8/4/1998	-0.29%	2.16%	1.64%	-1.35%	-1.18%	-0.51%	-0.82%	-0.07%	-1.22%	-0.16%	-0.18%
8/5/1998	2.75%	1.93%	0.68%	2.60%	2.04%	0.93%	-0.57%	0.38%	-0.59%	2.56%	1.27%
8/6/1998	2.25%	1.68%	2.01%	0.36%	0.17%	-0.33%	-1.35%	0.15%	0.85%	1.34%	0.66%
8/7/1998	3.05%	2.99%	0.79%	0.26%	-0.23%	0.03%	0.12%	0.39%	2.93%	-0.10%	0.67%
8/10/1998	3.48%	1.69%	1.53%	0.91%	0.48%	2.23%	1.03%	-0.23%	0.68%	0.27%	1.27%
8/11/1998	2.34%	1.72%	0.81%	-0.24%	0.60%	1.18%	-0.36%	0.79%	-0.29%	-0.14%	0.59%
8/12/1998	4.83%	2.88%	2.71%	1.31%	0.96%	0.58%	2.01%	0.93%	1.00%	0.68%	2.04%
8/13/1998	3.74%	2.24%	0.88%	2.72%	0.37%	0.39%	1.03%	0.48%	-0.11%	0.04%	1.33%
8/14/1998	2.25%	1.64%	3.57%	1.42%	-0.46%	-0.05%	0.66%	-0.07%	0.77%	-0.42%	0.94%
8/17/1998	2.46%	2.48%	1.81%	0.11%	-0.32%	1.66%	-0.01%	-0.80%	0.11%	0.49%	0.96%
8/18/1998	4.31%	1.85%	1.75%	3.86%	0.35%	-0.16%	-2.12%	0.03%	0.29%	0.12%	0.87%
8/19/1998	2.60%	2.15%	1.16%	0.45%	-0.65%	-0.36%	0.34%	-0.80%	0.06%	-0.13%	0.63%
8/20/1998	1.60%	3.04%	1.49%	0.42%	-0.64%	0.55%	0.87%	-0.61%	-0.55%	-1.47%	0.46%
8/21/1998	2.26%	4.06%	2.18%	1.79%	1.03%	-0.06%	-0.28%	-0.51%	0.06%	-0.36%	1.04%
8/24/1998	5.35%	1.84%	4.13%	0.63%	-0.83%	0.13%	-1.57%	-1.02%	-0.68%	0.73%	0.90%
8/25/1998	2.05%	2.19%	1.76%	0.85%	-0.45%	-0.34%	0.91%	-1.46%	-0.48%	-0.56%	0.36%
8/26/1998	4.02%	1.39%	1.78%	0.81%	-0.31%	0.06%	-0.43%	1.03%	-0.65%	-0.26%	0.61%
8/27/1998	1.69%	1.15%	0.24%	-1.16%	-2.02%	-0.47%	-1.54%	-1.91%	-0.63%	-2.20%	-0.78%
8/28/1998	2.52%	2.29%	1.33%	1.35%	0.11%	1.12%	-1.29%	-1.32%	-1.18%	-0.36%	0.39%
8/31/1998	3.31%	1.79%	0.51%	-0.36%	-3.44%	-1.97%	-3.08%	-4.47%	-2.73%	-2.82%	-1.62%
9/1/1998	4.96%	4.42%	6.04%	4.67%	9.06%	6.68%	6.71%	6.67%	4.90%	6.10%	6.59%
9/2/1998	4.43%	2.74%	1.90%	0.82%	-1.33%	0.25%	0.86%	-0.39%	0.45%	0.33%	0.63%
9/3/1998	3.89%	3.78%	2.08%	2.09%	0.23%	-0.03%	0.79%	0.15%	0.51%	0.76%	1.41%
9/4/1998	5.10%	3.95%	2.09%	0.75%	-0.33%	-0.84%	-1.33%	-1.61%	-1.15%	-3.68%	0.26%
9/8/1998	3.53%	3.40%	3.82%	0.57%	0.60%	0.82%	1.35%	1.05%	0.97%	3.73%	2.08%
9/9/1998	1.99%	3.62%	1.38%	1.15%	1.12%	1.66%	1.70%	2.10%	2.32%	2.92%	2.42%
9/10/1998	4.26%	2.68%	0.08%	2.05%	0.96%	-0.27%	0.64%	-0.86%	-0.67%	-2.16%	0.29%
9/11/1998	3.34%	3.17%	2.15%	0.77%	0.20%	0.50%	-0.95%	1.28%	-0.18%	0.15%	1.24%
9/14/1998	3.53%	3.58%	1.54%	0.83%	-0.20%	-0.42%	-0.47%	-0.50%	0.02%	-0.23%	0.33%
9/15/1998	3.62%	2.36%	1.34%	0.77%	-0.17%	-0.98%	-0.52%	-1.15%	-0.95%	-0.63%	0.14%
9/16/1998	2.71%	3.33%	0.89%	1.48%	0.58%	0.83%	0.00%	0.05%	1.53%	-0.04%	1.01%
9/17/1998	3.70%	2.24%	1.54%	1.56%	-0.95%	0.23%	1.10%	-0.40%	-0.86%	0.38%	0.79%
9/18/1998	4.01%	3.94%	2.67%	1.27%	2.55%	1.20%	-1.17%	-1.41%	-0.51%	-0.45%	1.07%
9/21/1998	3.22%	1.28%	1.86%	-0.61%	-0.87%	-0.09%	-2.22%	1.08%	-0.47%	-0.32%	0.19%
9/22/1998	3.26%	2.15%	1.68%	1.76%	-0.21%	-0.16%	-0.62%	-2.06%	-1.46%	0.16%	0.42%
9/23/1998	4.24%	2.16%	0.78%	-1.66%	-0.34%	-2.33%	-3.08%	-3.27%	-0.60%	-0.42%	-0.71%
9/24/1998	2.54%	1.47%	3.13%	1.60%	0.63%	-0.38%	-0.06%	-0.27%	0.59%	1.63%	1.21%
9/25/1998	2.28%	3.27%	0.16%	0.86%	0.28%	-0.90%	-0.66%	0.67%	1.16%	0.36%	0.61%
9/28/1998	4.24%	1.24%	1.81%	2.64%	0.52%	-1.30%	0.47%	-1.58%	-0.59%	0.16%	0.60%
9/29/1998	2.75%	1.48%	-0.07%	0.81%	-0.83%	-1.61%	-1.58%	-0.83%	-1.19%	-0.83%	-0.29%
9/30/1998	2.98%	0.41%	0.33%	-0.96%	0.01%	-1.00%	-1.78%	-0.41%	-0.10%	-0.74%	-0.33%

Table 5: Daily returns of Lo and MacKinlay's (1990) contrarian trading strategy applied to all U.S. common stocks (CRSP share codes 10 and 11) with share prices above \$5 and less than \$2,000, and market-capitalization deciles, from Monday August 3, 1998 to Friday September 30, 1998. Highlighted dates are: August 17 (default of Russian GKO bonds), August 21 (LTCM loses \$550MM in one day), September 3 (first LTCM letter to investors regarding their losses), and September 24 (news about the bailout by the consortium).

### Growth of Equity Hedge Funds and AUM Per Fund In The TASS Database

January 1994 to July 2007

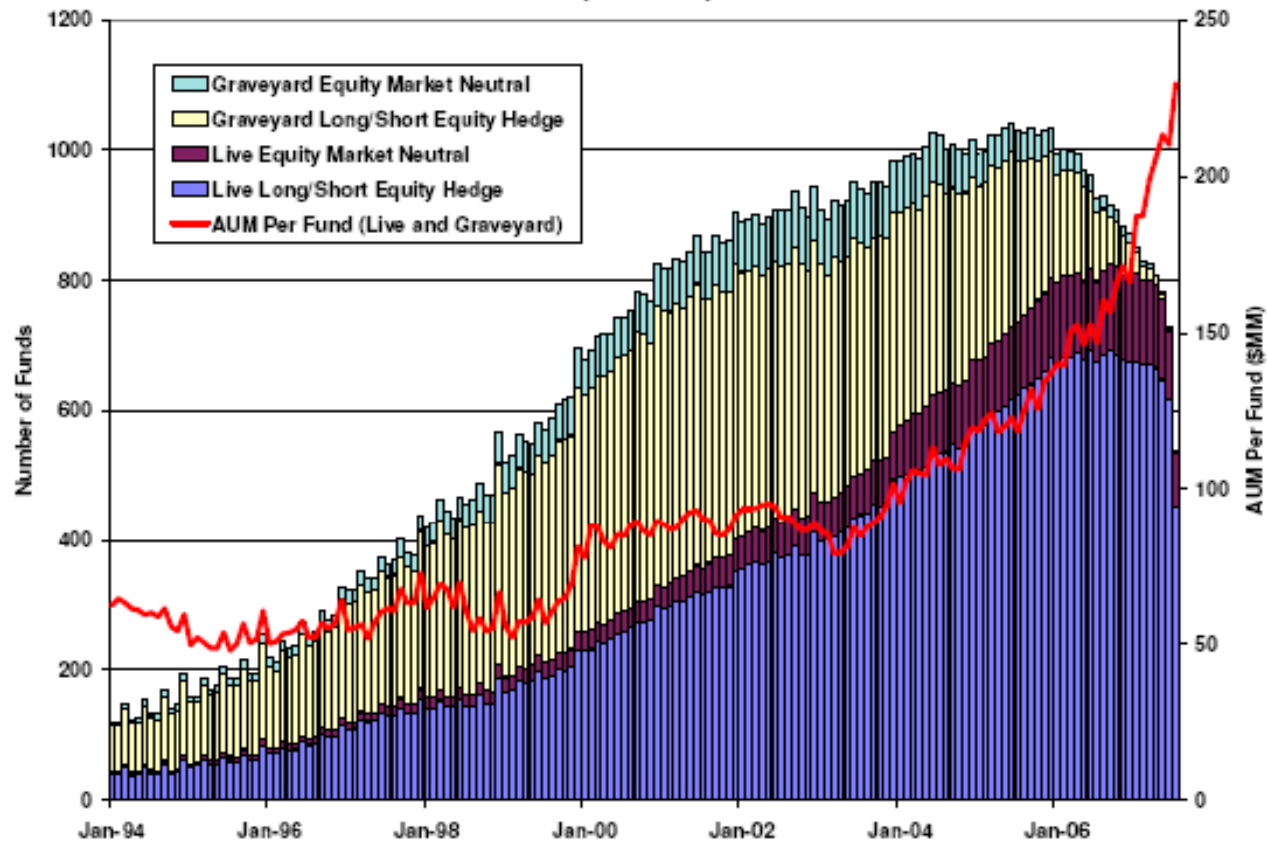


Figure 3: Number of funds in the Long/Short Equity Hedge and Equity Market Neutral categories of the TASS database, and average assets under management per fund, from January 1994 to July 2007.

**AUM in TASS Equity Hedge Funds and  
the Profitability of the Contrarian Trading Strategy  
1995 to 2007**

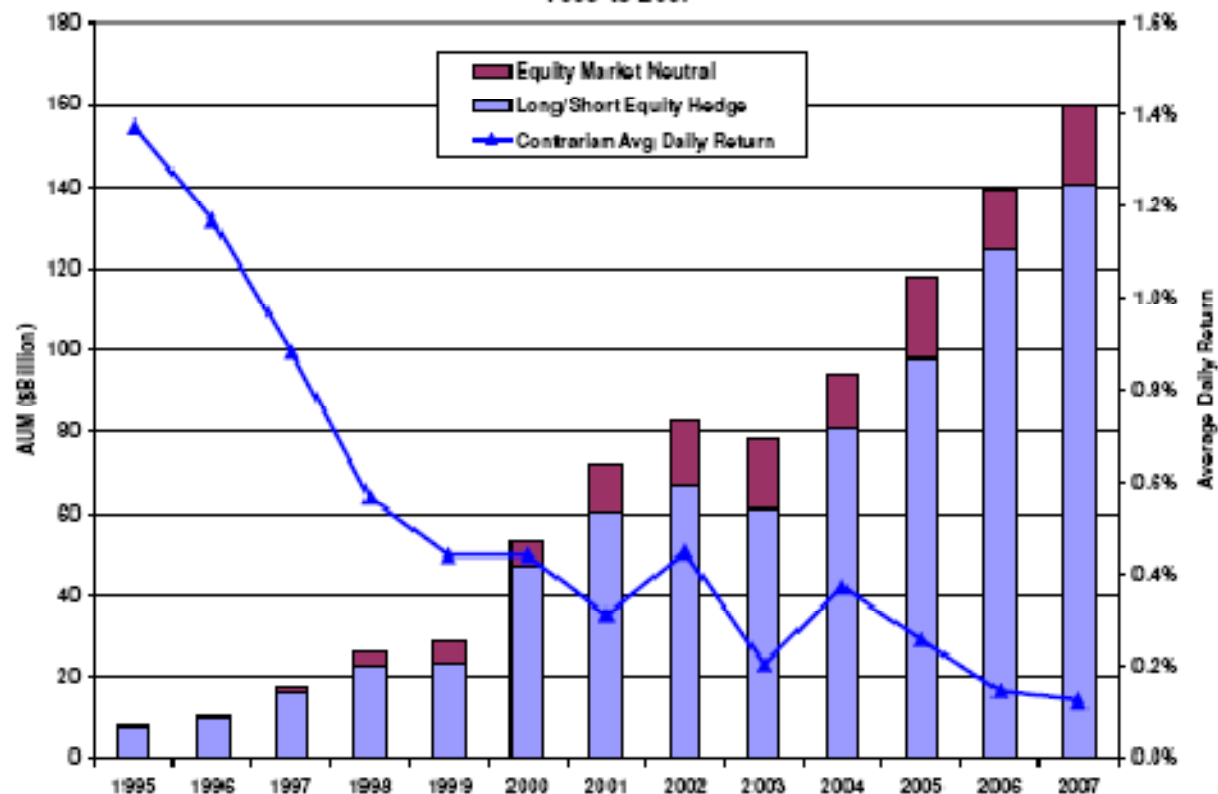


Figure 4: Beginning-of-year assets under management for funds in Long/Short Equity Hedge and Equity Market Neutral categories of the TASS database, from 1995 to 2007, and year-by-year average daily returns of Lo and MacKinlay's (1990) contrarian trading strategy applied to all U.S. common stocks (CRSP share codes 10 and 11) with share prices above \$5 and less than \$2,000, from January 3, 1995 to August 31, 2007.

Απαιτούμενη μόχλευση για σταθερές αποδόσεις:

$$E[L_{pt}] \equiv \frac{\theta^*}{2} E[R_{pt}] = E[R_{p,1998}]$$

$$\theta^* = \frac{2 E[R_{p,1998}]}{E[R_{pt}]}, \quad t = 1999, \dots, 2007$$

Year	Average Daily Return	Return Multiplier	Required Leverage Ratio
1998	0.57%	1.00	2.00
1999	0.44%	1.28	2.57
2000	0.44%	1.28	2.56
2001	0.31%	1.81	3.63
2002	0.45%	1.26	2.52
2003	0.21%	2.77	5.53
2004	0.37%	1.52	3.04
2005	0.26%	2.20	4.40
2006	0.15%	3.88	7.76
2007	0.13%	4.48	8.96

Table 6: Year-by-year average daily returns of Lo and MacKinlay's (1990) contrarian trading strategy applied to all U.S. common stocks (CRSP share codes 10 and 11) with share prices above \$5 and less than \$2,000, from 1998 to 2007, and the return multipliers and leverage factors needed to yield the same average return as in 1998.

Date	Deciles by Market Capitalization										All
	Smallest	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Largest	
7/30/2007	-0.28%	0.08%	7.85%	-1.43%	0.29%	0.91%	1.04%	1.51%	2.05%	0.71%	1.77%
7/31/2007	0.77%	4.41%	1.12%	2.20%	-2.53%	0.09%	-3.19%	1.94%	-1.23%	0.22%	1.46%
8/1/2007	6.10%	1.78%	-5.55%	1.39%	3.79%	-3.52%	-2.83%	-2.52%	-8.06%	-0.90%	0.43%
8/2/2007	3.54%	-3.04%	-0.46%	-2.68%	-3.77%	-10.79%	8.63%	6.12%	-2.97%	-0.77%	-1.22%
8/3/2007	-3.79%	-2.49%	-3.12%	0.24%	3.52%	0.05%	-2.49%	-4.35%	-2.29%	-2.74%	-0.10%
8/6/2007	-3.33%	-7.06%	-1.57%	-4.12%	5.47%	-5.47%	-4.75%	-2.86%	1.06%	3.08%	2.01%
8/7/2007	<b>3.00%</b>	<b>1.03%</b>	<b>-6.55%</b>	<b>-11.65%</b>	<b>-6.01%</b>	<b>-2.79%</b>	<b>1.42%</b>	<b>-4.08%</b>	<b>-6.86%</b>	<b>-2.67%</b>	<b>-4.64%</b>
8/8/2007	<b>3.52%</b>	<b>-5.30%</b>	<b>-10.36%</b>	<b>-14.58%</b>	<b>-17.07%</b>	<b>-8.65%</b>	<b>-8.94%</b>	<b>-13.85%</b>	<b>-5.06%</b>	<b>-5.91%</b>	<b>-11.33%</b>
8/9/2007	<b>3.66%</b>	<b>-7.42%</b>	<b>-15.46%</b>	<b>-11.08%</b>	<b>-12.72%</b>	<b>-15.78%</b>	<b>-13.06%</b>	<b>-17.33%</b>	<b>-10.32%</b>	<b>-5.22%</b>	<b>-11.43%</b>
8/10/2007	<b>-1.32%</b>	<b>14.62%</b>	<b>24.32%</b>	<b>31.58%</b>	<b>35.08%</b>	<b>30.67%</b>	<b>30.07%</b>	<b>26.79%</b>	<b>18.73%</b>	<b>9.55%</b>	<b>23.67%</b>
8/13/2007	5.42%	-1.24%	-2.53%	-4.26%	-6.20%	-0.88%	-5.15%	-8.04%	-8.58%	-4.99%	-3.05%
8/14/2007	4.65%	3.64%	-1.02%	1.35%	2.23%	-1.12%	2.74%	-1.16%	0.66%	0.67%	0.33%
8/15/2007	3.52%	4.74%	-2.42%	-2.33%	-0.69%	-3.89%	-0.97%	-5.36%	-2.29%	-4.73%	-1.53%
8/16/2007	-5.03%	-2.16%	0.59%	-2.36%	-2.39%	-3.95%	-6.94%	-5.08%	1.08%	-7.31%	-3.24%
8/17/2007	14.30%	9.94%	0.41%	5.04%	5.32%	-2.07%	0.47%	-1.56%	1.24%	0.44%	1.53%
8/20/2007	15.02%	7.02%	1.42%	5.40%	2.03%	1.74%	4.88%	2.22%	1.57%	4.67%	4.58%
8/21/2007	4.98%	0.43%	0.02%	-1.80%	0.09%	-2.54%	-0.33%	-0.20%	0.74%	0.43%	0.24%
8/22/2007	-3.39%	-1.23%	-2.07%	-2.05%	-0.67%	-3.31%	-0.74%	-2.26%	1.57%	0.37%	-1.51%
8/23/2007	-0.14%	2.79%	2.79%	-0.64%	1.51%	4.15%	1.04%	-1.33%	1.28%	1.23%	1.31%
8/24/2007	2.47%	-1.13%	-0.26%	0.92%	3.70%	-0.23%	-0.29%	0.37%	-1.42%	2.43%	1.73%
8/27/2007	4.38%	2.80%	0.46%	0.78%	5.01%	-0.63%	1.58%	2.85%	2.84%	0.10%	2.99%
8/28/2007	1.64%	1.26%	0.34%	-2.45%	-2.56%	-1.99%	-1.33%	-1.77%	-1.88%	0.99%	-3.04%
8/29/2007	5.79%	0.31%	5.07%	8.32%	7.75%	-2.14%	5.67%	6.39%	3.63%	3.94%	7.06%
8/30/2007	4.27%	0.16%	2.46%	1.61%	3.55%	0.41%	-0.11%	-0.16%	0.47%	-0.19%	2.01%
8/31/2007	6.75%	3.86%	3.80%	-2.21%	0.21%	2.08%	-0.32%	-2.68%	0.02%	0.58%	1.46%

Table 7: Leveraged daily returns of Lo and MacKinlay's (1990) contrarian trading strategy applied to all U.S. common stocks (CRSP share codes 10 and 11) with share prices above \$5 and less than \$2,000, and market-capitalization deciles, from Monday July 30, 2007 to Friday August 31, 2007, with 8:1 leverage or a return multiplier of 4.

### Daily Returns in August 2007 of Leveraged Contrarian Strategy and Miscellaneous Indexes

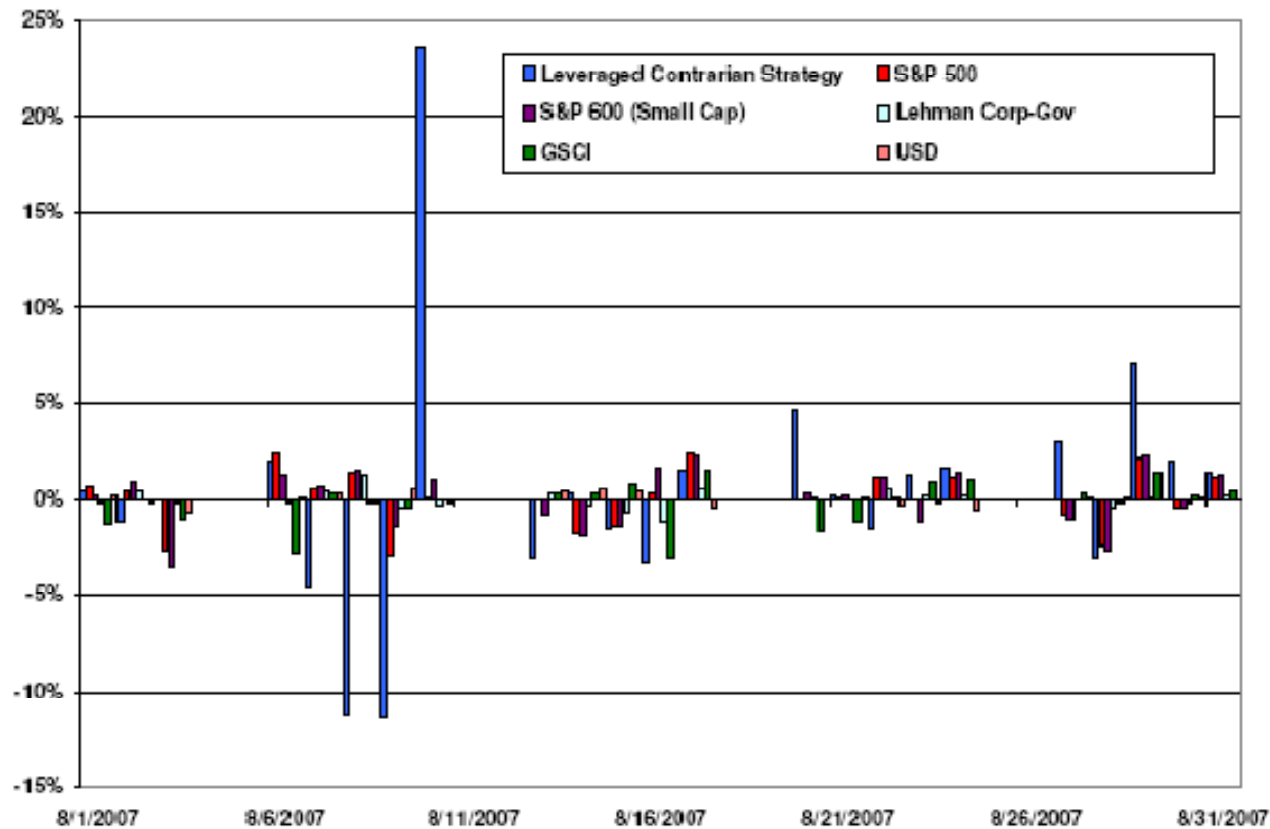


Figure 5: Leveraged daily returns of Lo and MacKinlay's (1990) contrarian trading strategy applied to all U.S. common stocks (CRSP share codes 10 and 11) with share prices above \$5 and less than \$2,000, and miscellaneous indexes, for the month of August 2007, with 8:1 leverage or a return multiplier of 4.

Mean, Median, and Asset-Weighted 60-Month Rolling Autocorrelations for TASS Long/Short Equity Hedge and Equity Market Neutral Funds, December 1994 to June 2007

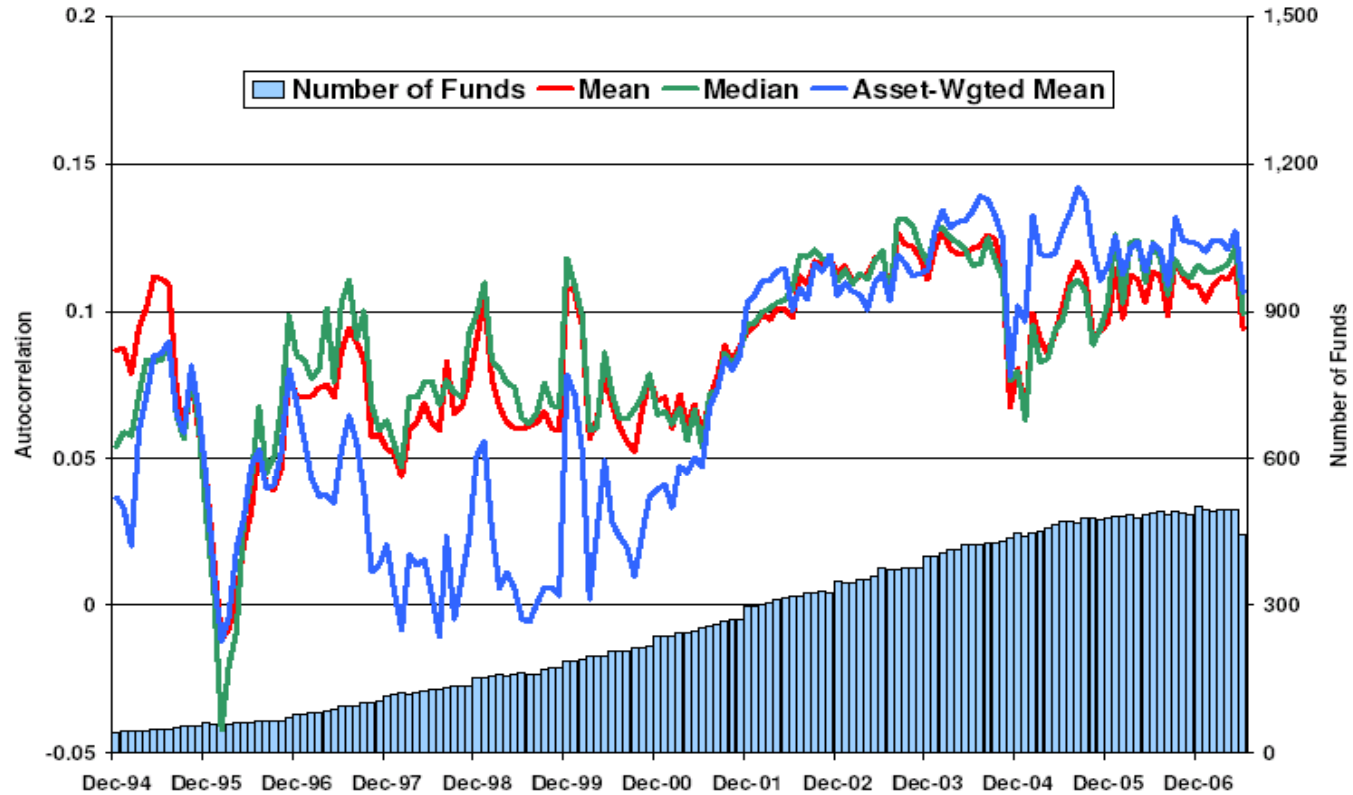


Figure 7: Mean, median, and asset-weighted mean 60-month rolling autocorrelations of funds in the TASS Live and Graveyard database in the Long/Short Equity Hedge and Equity Market Neutral categories, from December 1994 to June 2007.



### Mean and Median Absolute 36-Month Rolling-Window Correlations Among CS/Tremont Hedge-Fund Indexes

March 1997 to June 2007

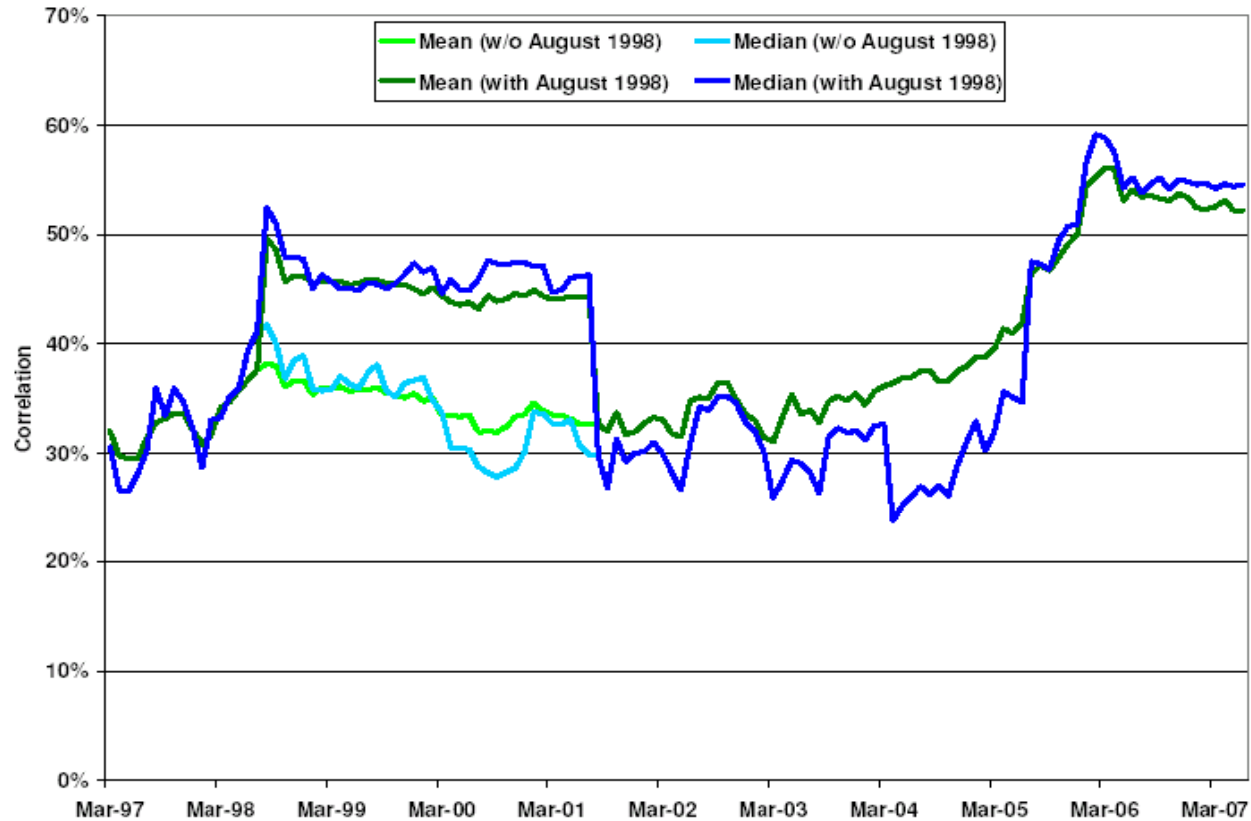


Figure 9: Mean and median absolute 36-month rolling-window correlations among CS/Tremont hedge-fund indexes from March 1997 to June 2007, with and without August 1998.

# Μερικά Συμπεράσματα

Αποτέλεσμα ξαφνικής ρευστοποίησης θέσεων πιθανώς λόγω απολειών sub-prime και νέας πραγματικότητας με:

- Αυξημένη αξία θέσεων υπό διαχείριση με ποσοτικές στρατηγικές
- Ψηλή συσχέτιση μεταξύ τους
- Αυξημένη μόχλευση
- Υπερτίμηση ρευστότητας

Προβλήματα ρευστότητας μεταδίδονται πολύ πιο γρήγορα τώρα από ότι παλαιότερα

Επενδύσεις έχουν κοινούς παράγοντες κινδύνου

Απαιτείται ρύθμιση εξωτερικότητων από επενδύσεις hedge funds

Άπαιτούνται μέτρα ρευστότητας που να επηρεάζουν μέτρα κινδύνου

Ρόλος τεχνολογίας και **αυτοματοποίησης αγορών**  
(Jain & Johnson 2006; Jain 2005)

$$\text{Proportional Quoted Spread} = \frac{\text{Ask Price} - \text{Bid Price}}{\text{Quote Midpoint}} * 100$$

**Table 1. Technology (T), Regulatory Advancements (R), Financial Shocks, Optimistic Sentiments or Scandals (S), and Liquidity on NYSE**

<u>Year</u>	<u>Description</u>	<u>T, R, S</u>	<u>Spreads (bp) from Jones (2002)</u>	<u>Change in Spreads</u>
1792	Buttonwood Agreement: 24 prominent brokers gather on Wall Street agreeing to trade securities on a commission basis. The New York Stock Exchange begins.	R	-	-
1844	Telegraph allows brokers outside of NY instant access to exchange	T	-	-
1866	Trans-Atlantic cable provides instant communication between Europe and US markets	T	-	-
1871	Continuous trading via specialists replaces the older call auction trading system	T	-	-
1878	First Telephone installed on floor	T	-	-
1881	The first annunciator board is installed for paging members.	T	-	-
1899	Listed companies required to submit regular financial statements	R	70	-
1903	Move To Current Larger Trading Floor Site	T	55	-15
1906	DJIA Index set all time high record of 100	-	25	-30
1907	Financial problems at Knickerbocker Trust triggers a run on banks.	S	77	52
1911	Kansas adopts "Blue Sky" law imposing registration requirements on issuers and brokers	R	55	-22
1913	Federal Reserve System established to control credit and bank stability	R	45	-10
1914	World War I causes exchange to close for 4 ½ months	S	102	57
1918	An expanded pneumatic tube system goes into operation. Also, America emerges from the war as a creditor nation, and Wall Street supplants London as the world investment capital.	T,S	76	-26
1920	Centralized Clearing System established	T	80	4
1923	Fraud Bureau established to eliminate stock market gamblers and fraudulent security sales. Start of a bull market.	R,S	57	-23
1926	Listing Rules tighten	R	50	-7
1929	Central quote system installed to provides instantaneous bid-ask prices by phone. Markets crash in 1929.	T,S	58	8
1930	High speed Black Box ticker introduced	T	53	-5

1932	Dow reaches bottom. 89% below 1929 peak	S	150	97
1933	The Securities Act of 1933	R	95	-55
1934	The Securities Exchange Act of 1934 establishes SEC	R	92	-3
1945	World War II ends with Allied Victory	S	65	-27
1953	NYSE permits member firms to incorporate giving them greater access to capital. Volumes exceed 1 mil shares daily consistently	R,S	77	12
1956	Listed companies urged to include outside directors on boards	R	70	-7
1957	Ebasco service report suggests automating the trading floor with respect to transaction reporting and improved stock clearing and quotation service.	T	65	-5
1959	NYSE discourages trading by company insiders	R	63	-2
1964	900 Ticker System with twice the speed replaces the Black Box system	T	45	-18
1966	Transmission of trade and quote data from the floor is fully automated. Radio paging begins. Congress creates Securities Investor Protection Corporation, to protect customers of failed brokerage firms.	T,R	55	10
1968	Central Certificate Service is established to transfer securities electronically. Surging volumes precipitate Paperwork Crisis.	T	55	0
1972	Securities Industry Automation Corp. Established	T	60	5
1973	Oil embargo cripples markets worldwide	S	70	10
1975	Fixed commissions abolished	R	77	7
1976	Automated Designated Order Turnaround (DOT) system is introduced to electronically route smaller orders	T	50	-27
1978	Inter-market Trading System launches providing electronic link between NYSE and competing exchanges, enabling brokers access to all markets.	T	45	-5
1984	Launch of Super DOT 250 an electronic order-routing system that links member firms to specialist posts on the trading floor.	T	41	-4
1987	Dow loses 22.61% on October 19, largest one day drop	S	57	16
1988	Circuit Breakers installed to coordinate procedures between NYSE and Chicago Mercantile Exchange to control extreme price movements and share surveillance data	T	48	-9
1991	Off-hours trading until 5:15 p.m. introduced	T	45	-3
1993	Integrated technology plan is begun to enhance trading floor networks to handle over 1 billion shares per day.	T	35	-10
1994	Trading post upgrades to include handheld terminals, fiber optics, and cellular communications.	T	30	-5
1995	Video: Trading Posts Upgrade to make use of the most sophisticated technology of	T	26	-4

the time. Handheld terminals, fiber optics, cellular communications and the first large-scale application of high-definition flat-screen technology were installed to speed market information and strengthen trading floor professionals' ability to manage orders.

1996	Real time ticker available to all investors on CNBC and CNN-FN	T	20	-6
1997	Trading in Sixteenths Tick-Size. Wireless Data System installed to allow brokers to receive, access and transmit market information and trades from anywhere on trading floor.	R,T	16	-4
1999	NYSE requires domestic listed companies to seat at least three independent directors. NYSE unveils 3D Trading Floor, an advanced Trading Floor operations center. DJIA tops 10,000 for the first time	R,T,S	15	-1
2000	NYSE Direct + provides immediate automatic execution of limit orders up to 1,099 shares at NYSE quote. Decimal tick size trading begins. DJIA Index sees it biggest one day point rise and a month later biggest point decline.	T,R,S	19	4
2001	Complete transition to Decimal Trading. 9/11 Terrorist attacks	R,S	11	-8
2002	NYSE OpenBook <sup>®</sup> launches, a new market information product that provides off-floor market participants a view of the buy and sell interest in all NYSE-listed securities beyond the best bid and offer. The Sarbanes-Oxley Act , which aims to protect investors by improving the accuracy and reliability of corporate disclosures, goes into effect.	T,R	10	-1
2003	NYSE LiquidityQuote launches in a 28-stock pilot, disseminating executable, sizable quotes outside of the best bid or offer. Investors and market professionals can use this product to find greater market size and depth. SEC approves the NYSE's new corporate governance standards for listed companies, requiring boards of NYSE-listed companies to have a majority of independent directors	T,R	7	-3
2004	NYSE expands Direct + system significantly increasing the level of purely electronic trading.	T	5	-2
2005	NYSE and ArcaEx Agree to Merge	S	4	-1

**Table 2. Floor trading versus electronic trading.**

<b><u>Characteristic</u></b>	<b><u>Floor Trading</u></b>	<b><u>Electronic Trading</u></b>
Trader identity	Face to face trading results in reputation building	Trader identity can be hidden or displayed
Order flow transparency	Order flow is hidden	Order flow is displayed
Quote transparency	Best quotes only are known	All quotes can be displayed
Quote life	Quotes evaporate and good only till the breath is warm	Quotes are firm till withdrawn or consumed
Trading speed	Slower order transmission and trade execution	Almost instantaneous execution of trades
Settlement	Slower settlement	Faster settlement
Exchange viability	Higher operating cost	Cheaper
Transaction costs	Higher transaction cost	Deeply discounted brokerage
Remote Access	Expensive remote access	Better accessibility
Competition among liquidity suppliers	Reliance on single/few market makers	Competition from numerous value trades

### **Table 3. Automation affects liquidity and cost of capital around the globe**

Turnover data is provided for 66 countries and cost of capital for 71 countries by Jain (2005). Changes are calculated by subtracting the level of liquidity or cost of capital before automation from their respective levels after automation.

	<b>Change in Liquidity</b>	<b>Change in Cost of Capital</b>
<b>Average Response to Automation: Entire Sample</b>	<b>3.02%</b>	<b>-1.23%</b>
Number of exchanges with positive change	47	14
Average change in positive countries	5.70%	0.79%
Number of countries with negative change	19	57
Average change in negative countries	-3.63%	-1.73%



**Figure 1. The Global Shift from Floor Trading to Electronic Trading**

Based on the leading stock exchange in 120 countries from 1975 to 2001

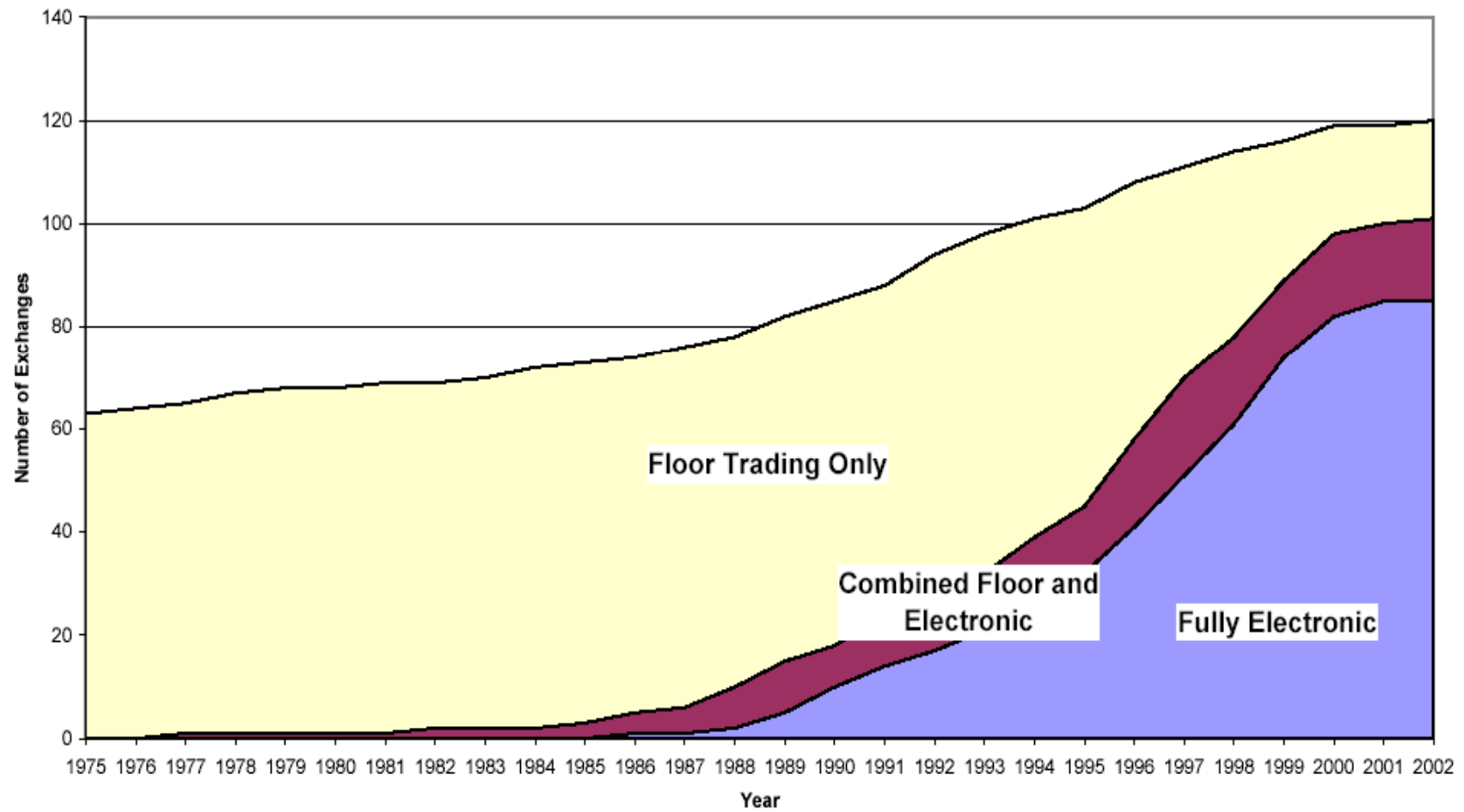
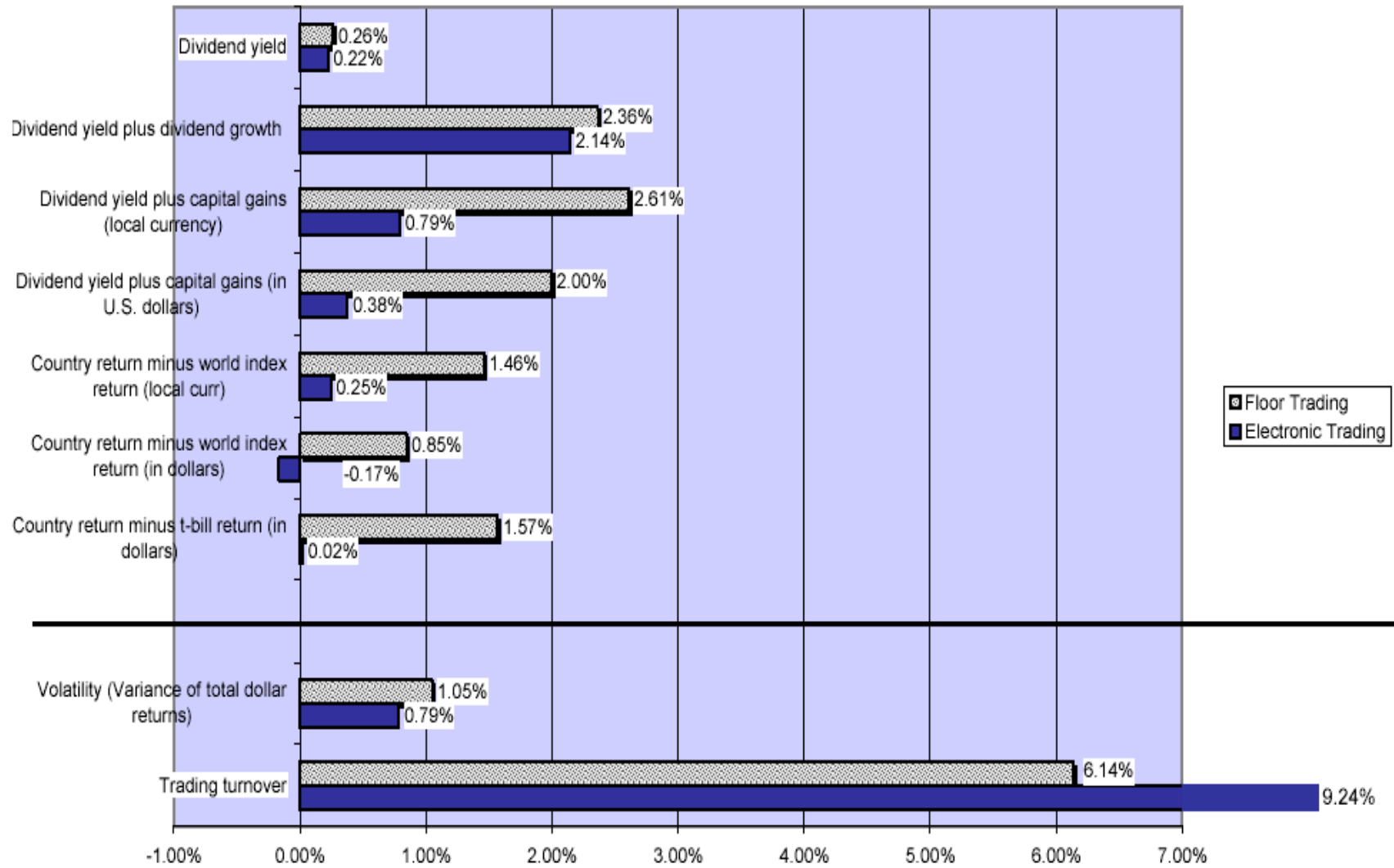


Figure 2. Declining Cost of Equity after Automation



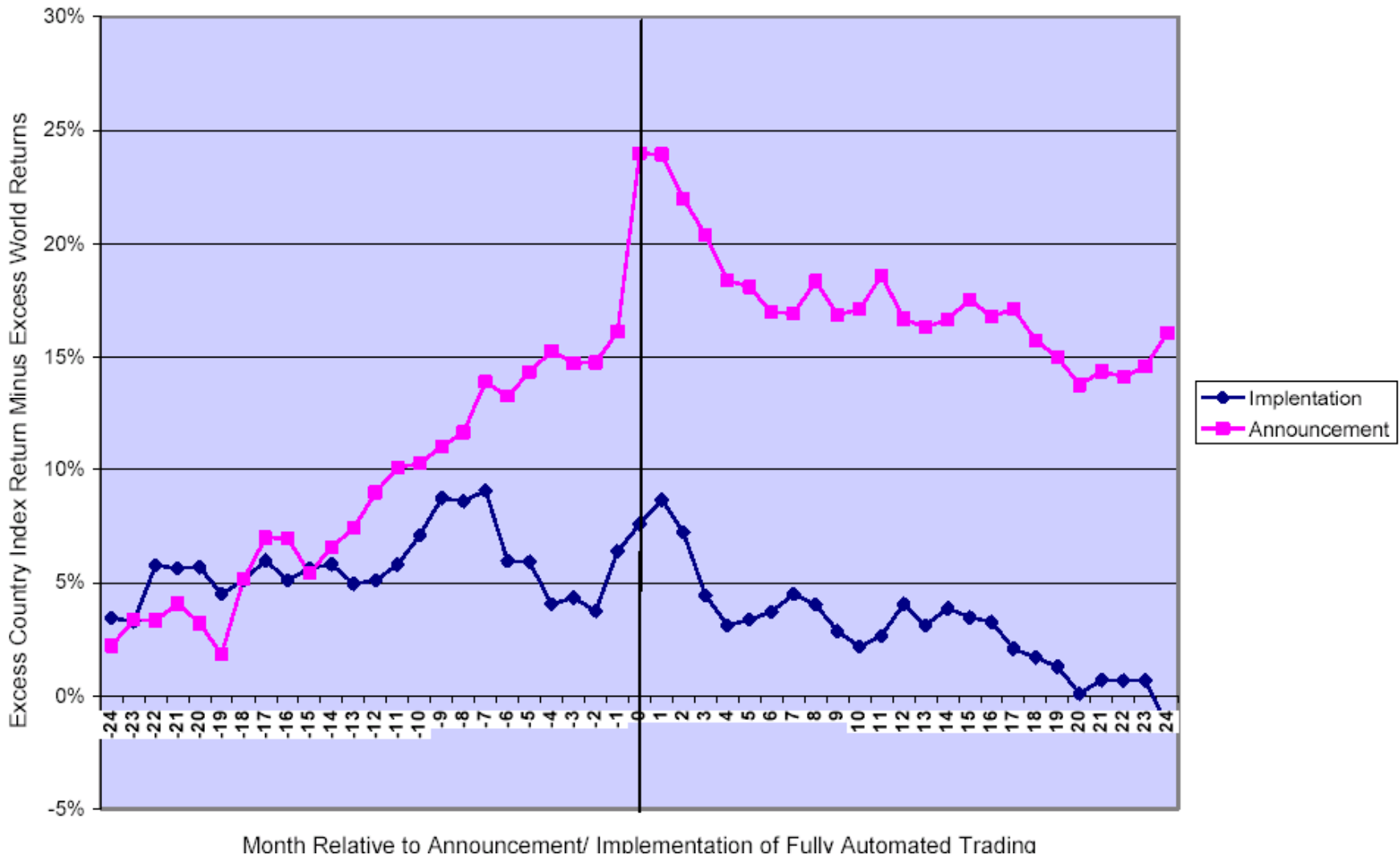
**Table 1. Country-by-country analysis of declining equity premium after Electronic Trading**

This table reports the changes in equity premium for 71 exchanges after the introduction of electronic trading. The six measures of expected returns are calculated for the floor trading months and the electronic months and the differences are reported here. Changes in trading turnover are in the last column.

Country	Change in dividend yields (DY)	Change in dividend yields plus capital gains (local currency, DYCG)	Change in dividend yields plus capital gains (in U.S. Dollars, DYCG\$)	Change in dividend yields plus dividend growth (DYG)	Excess Returns		Changes in Trading turnover (Turnover)
					Country return minus world return (in U.S. dollars, ERW\$)	Country return minus U.S. dollar t-bill return (ERT)	
<b>Panel A. Developed Countries</b>							
1 Australia	-0.04%	-1.52%	-1.13%	-1.76%	-0.30%	-0.82%	0.0253
2 Austria	0.01%	-0.46%	-1.19%	-0.01%	-0.84%	-1.14%	0.3063
3 Belgium	-0.17%	0.06%	-0.88%	-0.83%	-0.83%	-0.83%	0.1724
4 Canada	-0.08%	0.79%	0.45%	-0.46%	-0.41%	0.18%	0.0291
5 Denmark	-0.10%	-0.19%	0.27%	0.75%	0.80%	0.59%	0.0375
6 Finland	-0.02%	-0.48%	-0.37%	-0.50%	0.67%	-0.26%	0.0212
7 France	-0.18%	-1.13%	-0.60%	0.51%	-0.24%	-0.31%	-0.0170
8 Germany	-0.11%	-0.21%	-0.58%	-0.19%	-0.10%	-0.29%	0.1345
9 Hong kong	-0.08%	0.31%	0.76%	0.43%	1.03%	1.05%	0.0105
10 Ireland	-0.08%	-0.66%	-0.60%	0.55%	2.01%	-0.61%	-0.0171
11 Italy	-0.07%	-0.48%	-0.85%	-1.72%	-0.39%	-0.75%	0.0546
12 Japan	-0.10%	-0.17%	0.17%	-0.40%	-0.59%	0.19%	
13 Luxembourg	-0.14%	-1.41%	-1.39%	-1.14%	-1.54%	-1.20%	0.2398
14 Netherlands	-0.22%	0.20%	-0.67%	-0.24%	-0.07%	-0.60%	0.0908
15 New Zealand	-0.04%	0.76%	0.80%	-0.26%	0.81%	1.02%	0.0001
16 Norway	-0.12%	-0.82%	-0.85%	-1.77%	-0.22%	-0.54%	0.0529
17 Portugal	0.07%	1.48%	1.32%	-0.70%	1.29%	1.53%	0.0277
18 Singapore	-0.09%	-0.68%	-0.67%	-1.11%	-0.01%	-0.35%	0.0358
19 Spain	0.03%	-0.54%	-0.31%	-1.08%	0.26%	0.01%	0.0271
20 Sweden	-0.04%	-1.11%	-0.89%	-0.64%	-0.31%	-0.57%	-0.0146
21 Switzerland	-0.09%	0.16%	-0.65%	-0.27%	-0.41%	-0.61%	0.0246
22 UK	-0.17%	-0.74%	-0.98%	-1.40%	-0.48%	-0.93%	0.0543
23 US-NYSE	-0.20%	-2.94%	-2.94%	-0.33%	-0.28%	-2.90%	0.0018
Country	DY	DYCG	DYCG\$	DYG	ERW\$	ERT	Turnover
<b>Panel B. Emerging Countries</b>							
24 Argentina	0.12%	-12.82%	-4.39%	-2.30%	-4.44%	-4.35%	0.0032
25 Bahrain	0.00%	-1.88%	-1.88%	0.86%	0.57%	-1.90%	
26 Bangladesh	0.06%	-1.68%	-2.03%	1.02%	-0.74%	-2.02%	0.0366
27 Barbados		-1.97%	-1.93%		0.21%	-1.94%	-0.0114
28 Bermuda		-0.09%	-0.09%		-0.82%	-0.09%	
29 Brazil	-0.27%	6.84%	-2.88%	-4.05%	-2.84%	-2.66%	-0.0545
30 Bulgaria		-2.75%	-0.98%		-0.96%	-0.98%	
31 Chile	-0.46%	-1.42%	-1.47%	-1.15%	-1.02%	-1.27%	0.0003
32 China	-0.04%	0.48%	1.97%	-2.08%	0.71%	2.23%	-0.0023
33 Colombia	0.04%	-2.83%	-2.88%	-1.06%	-2.81%	-2.85%	0.0067
34 Croatia	-0.03%	2.20%	2.40%	3.15%	4.03%	2.38%	0.0009
35 Cyprus		1.71%	1.54%		3.14%	1.52%	0.2461
36 Czech	0.03%	-0.08%	0.02%	2.73%	1.52%	0.04%	0.0201
37 Ecuador		-0.15%	-2.18%		-1.34%	-2.19%	
38 Egypt	0.22%	-3.74%	-4.21%	-1.74%	-3.23%	-4.19%	0.0549
39 Greece	-0.03%	-1.84%	-1.87%	1.04%	-2.10%	-1.71%	0.0492
40 Hungary	-0.02%	-3.66%	-2.80%	2.68%	-1.65%	-2.82%	0.1212

Continued.....

Figure 3. Cumulative Excess-over-world Returns



Ρόλος τεχνολογίας και ***αυτοματοποίησης επενδύσεων***  
(Hendershott, Jones & Menkveld 2007)

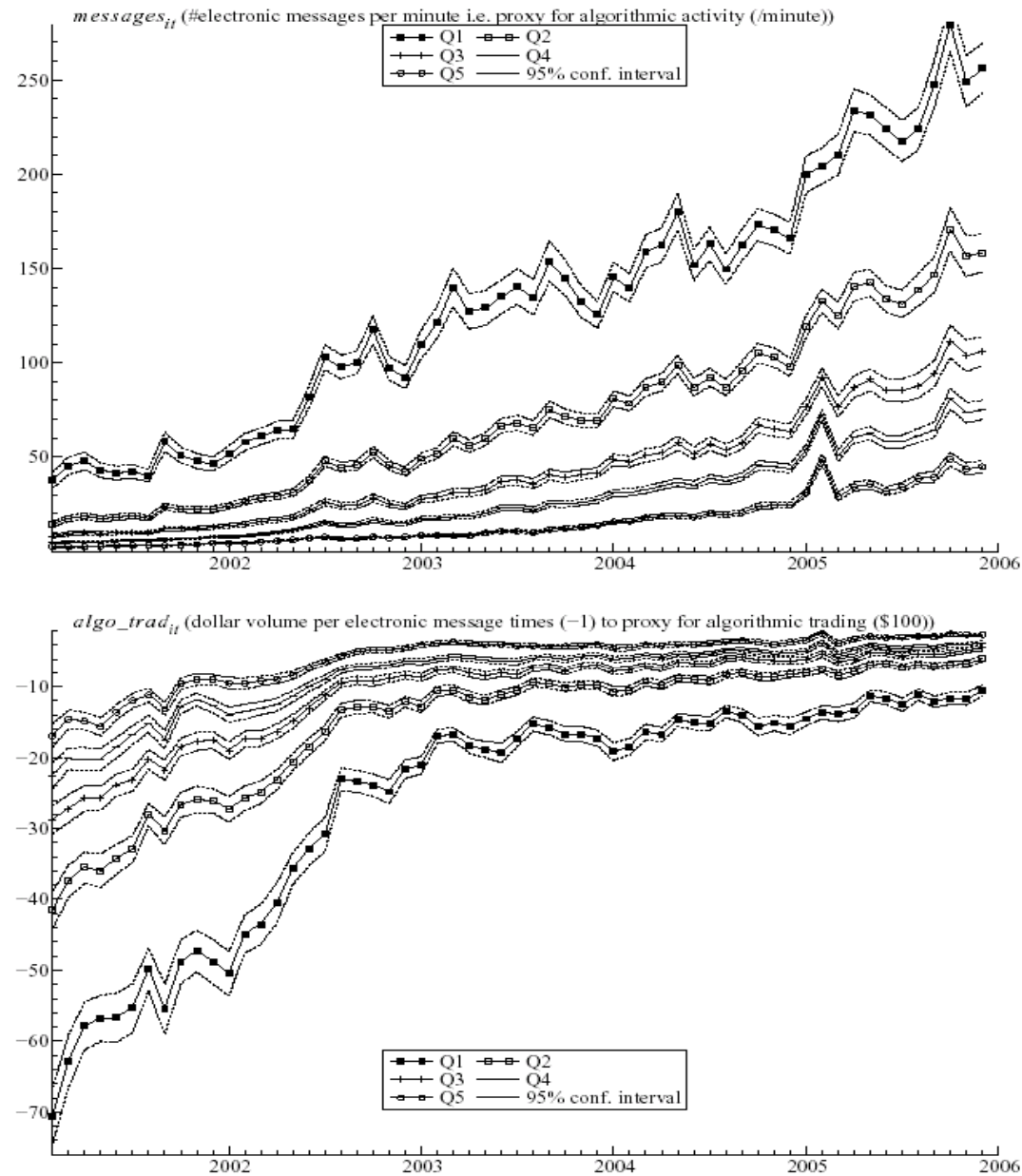
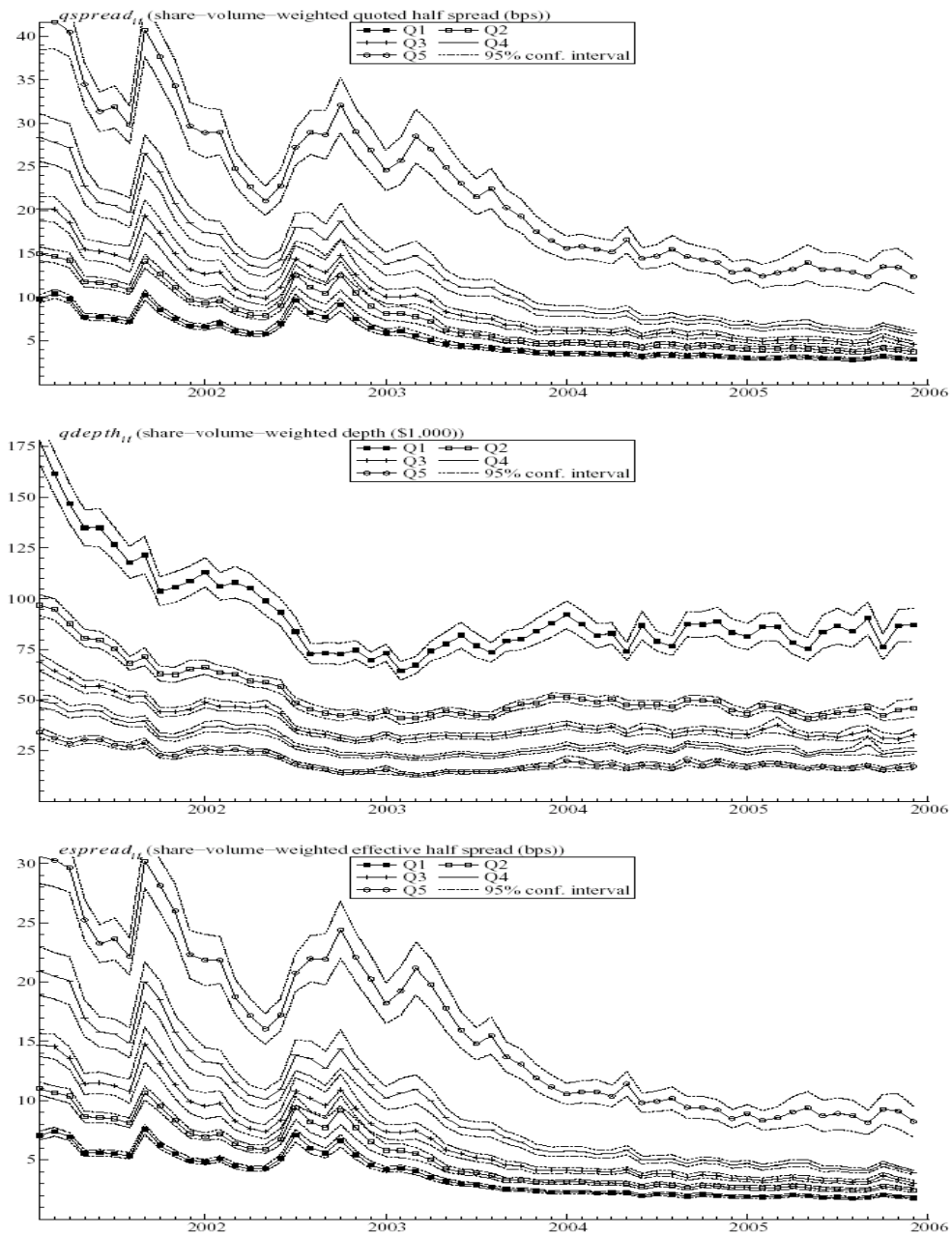


Figure 1: These graphs depict (i) the number of (electronic) messages per minute and (ii) our proxy for algorithmic trading, which is defined as the negative of trading volume (in thousands of dollars) divided by the number of messages. The graphs are done by market cap quintile, where Q1 is the large-cap quintile.



$$espread_{jt} = q_{jt}(p_{jt} - m_{jt})/m_{jt},$$

Figure 2: These graphs depict (i) quoted half spread, (ii) quoted depth, and (iii) effective spread. All spread measures are share-volume weighted averages. The graphs are done by market-cap quintile, where Q1 is the large-cap quintile.

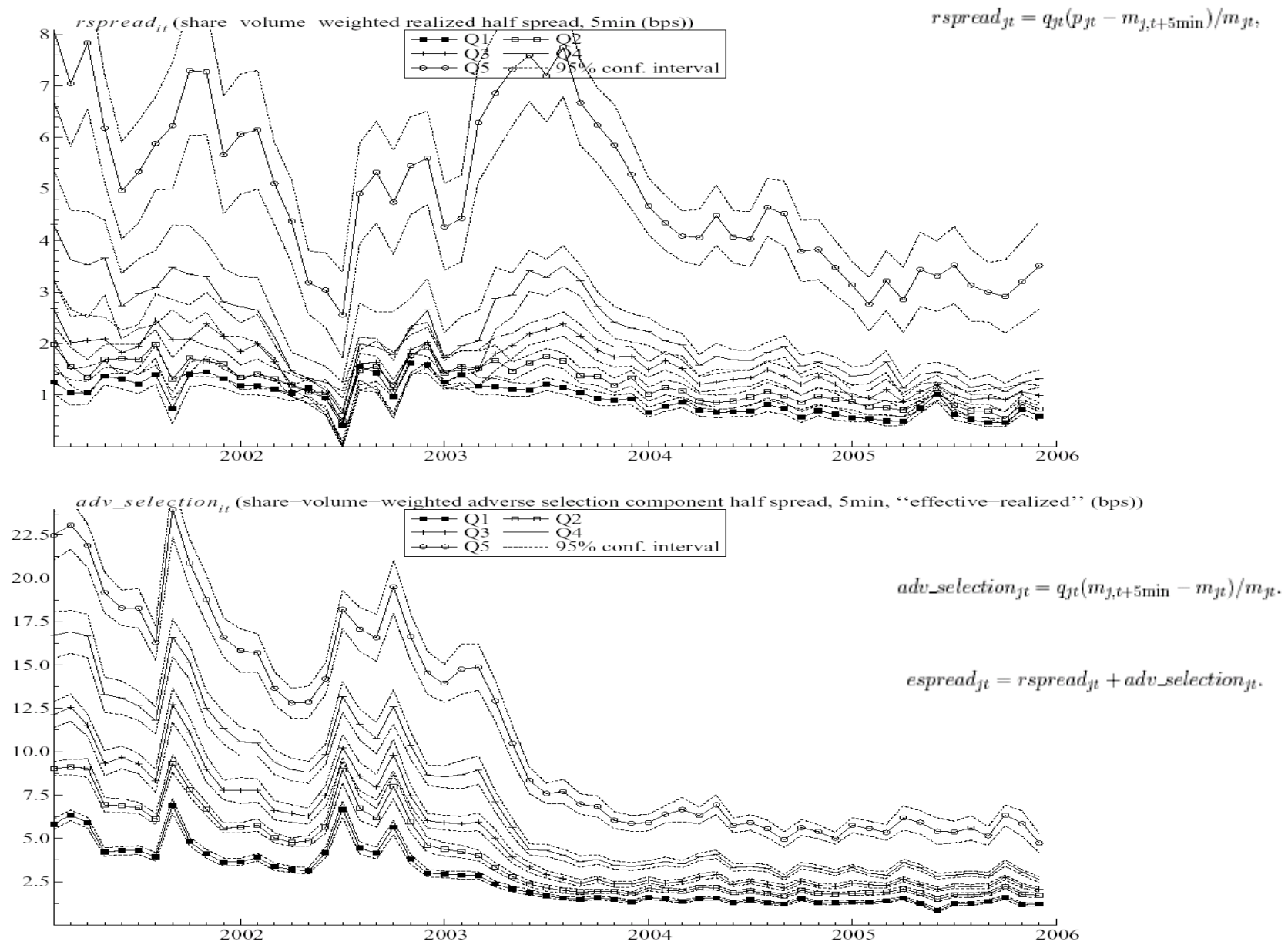


Figure 3: These graphs depict the two components of the effective spread: (i) realized spread and (ii) the adverse selection component, i.e. the (permanent) price impact. The spread decomposition is based on the 5 minute delayed spread midpoint. The graphs are done by market-cap quintile, where Q1 is the large-cap quintile.



**Table 5: Effect of AT on Spread: Nonsynchronous Autoquote Introduction as Instrumental Variable**

This table regresses various measures of the (half) spread on our algorithmic trading proxy. It is based on daily observations in the period when autoquote was phased in, i.e. December 2, 2002, through July 31, 2003. We use the exogenous nonsynchronous autoquote introduction to instrument for the endogenous  $algo\_trad_{it}$  to identify causality from algorithmic trading to liquidity. We estimate

$$L_{it} = \alpha_i + \gamma_t + \beta A_{it} + \delta X_{it} + \varepsilon_{it}$$

where  $L_{it}$  is a spread measure for stock  $i$  on day  $t$ ,  $A_{it}$  is the algorithmic trading measure  $algo\_trad_{it}$ , and  $X_{it}$  is a vector of control variables, including share turnover, volatility, 1/price, and log market cap. We always include fixed effects and time dummies. The set of instruments we use consists of all explanatory variables, except that we replace  $algo\_trad_{it}$  with  $auto\_quote_{it}$ . We regress by quintile and report  $t$ -values based on standard errors that are robust to general cross-section and time-series heteroskedasticity and within-group autocorrelation (see Arellano and Bond (1991)).

	Coefficient on $algo\_trad_{it}$					Coefficients on control variables <sup>a</sup>				time dummies	DF test statistic <sup>b</sup>
	Q1	Q2	Q3	Q4	Q5	$share\_turnover_{it}$	$vola-tility_{it}$	$1/price_{it}$	$ln\_mkt\_cap_{it}$		
<i>Panel A: quoted spread, quoted depth, and effective spread</i>											
$qspread_{it}$	-0.52** (-3.23)	-0.42** (-2.21)	-0.43 (-1.44)	-0.16 (-0.05)	9.92 (1.22)	-2.80** (-3.01)	0.90** (9.70)	108.30** (7.49)	-3.55** (-2.27)	Yes	-321.0**
$qdepth_{it}$	-3.47** (-2.50)	-1.43 (-1.16)	-1.99 (-1.07)	15.49 (0.39)	0.61 (0.19)	-5.16 (-0.64)	-1.64* (-1.87)	-3.90 (-0.03)	12.12 (0.83)	Yes	-300.3**
$espread_{it}$	-0.18** (-2.65)	-0.32** (-2.23)	-0.35 (-1.56)	-1.63 (-0.42)	4.65 (1.16)	-1.01** (-2.32)	0.69** (9.51)	72.72** (10.91)	-1.27 (-1.45)	Yes	-329.8**

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