Stock Volatility: Past, Present & Future

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(Data updated through 8/31/2009)

http://schwert.ssb.rochester.edu/volatility_2009.htm

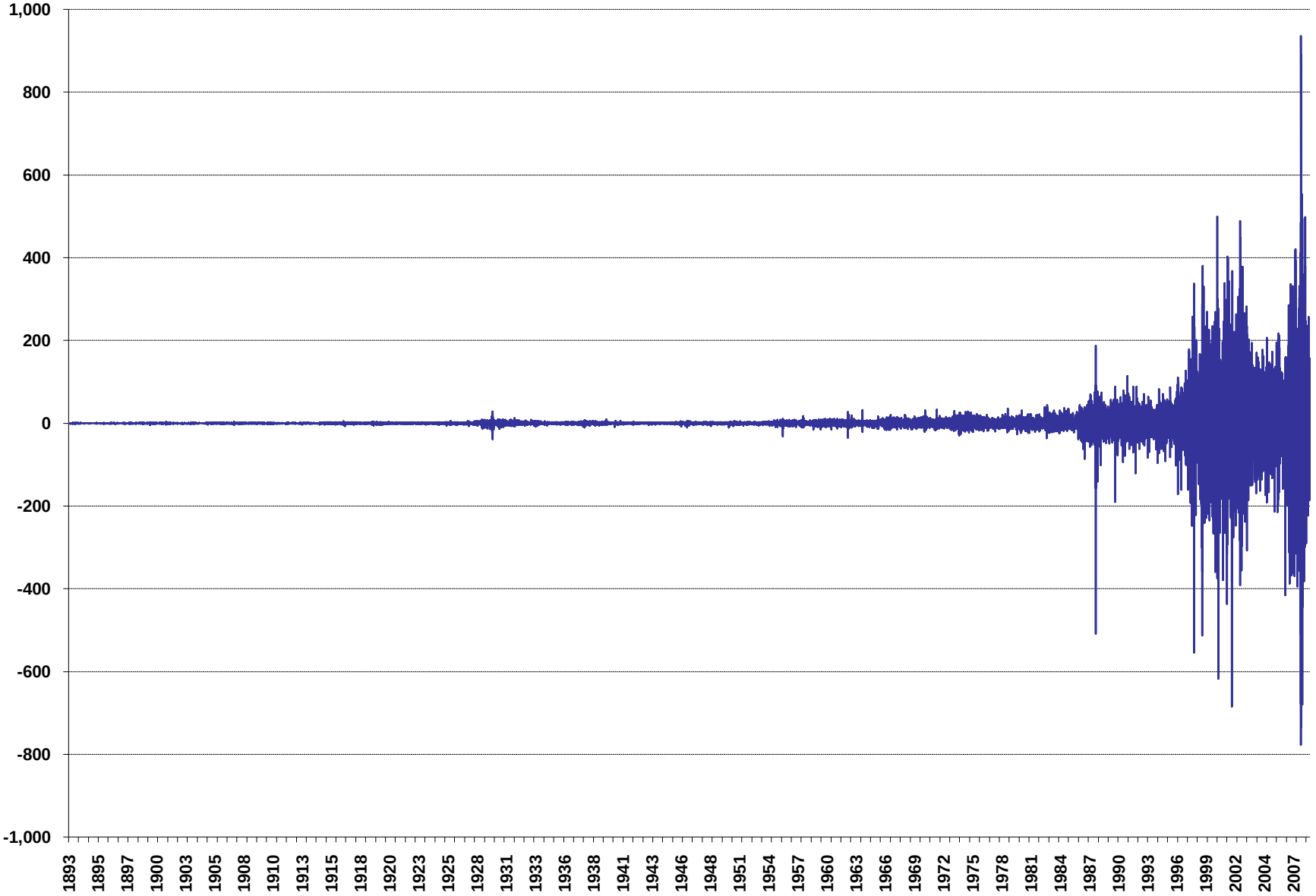
What is market volatility?

- Standard deviation of rates of return to broad market indexes
  - Following plots show:
    - Changes in Dow Jones Industrial Average from 1893-2009
      - Affected by growth in the level of the index
    - Percent changes in DJIA (rates of return, ignoring dividends) from 1893-2009
    - Rolling annualized standard deviations of rates of return to DJIA from 1893-2009

Looking at the absolute scale of stock indexes is very misleading . . .

- The sixty largest changes in the DJIA have been within the last 12 years
  - The only exception among these sixty days is Oct 19, 1987

Daily Changes in the Dow Jones Industrial Average, 1893-2009



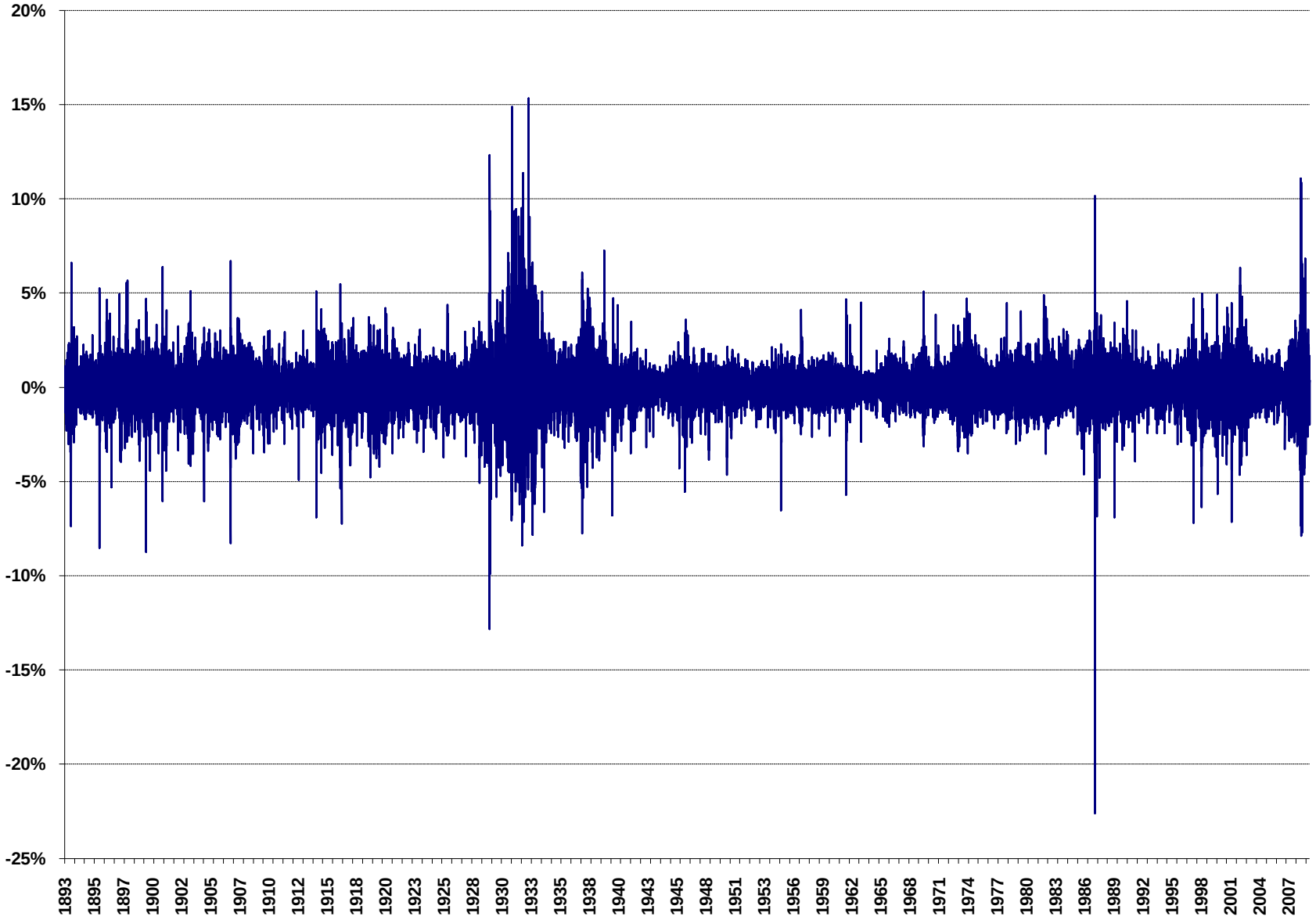
The Thirty Largest Daily Increases and Decreases in the Dow Jones Industrial Index, 1885-2009 (T=34,347)

		DJIA	Chg	Ret	Std		DJIA	Chg	Ret	Std
1	20080929	10365.45	-777.68	-6.98%	43.54%	20081013	9387.61	936.42	11.08%	68.53%
2	20081015	8577.91	-733.08	-7.87%	71.30%	20081028	9065.12	889.35	10.88%	82.63%
3	20010917	8920.70	-684.81	-7.13%	29.12%	20081113	8835.25	552.59	6.67%	68.67%
4	20081201	8149.09	-679.95	-7.70%	67.07%	20000316	10630.59	499.18	4.93%	32.58%
5	20081009	8579.19	-678.91	-7.33%	54.10%	20090323	7775.86	497.48	6.84%	46.70%
6	20000414	10305.77	-617.78	-5.66%	27.78%	20081121	8046.42	494.13	6.54%	71.80%
7	19971027	7161.15	-554.26	-7.18%	29.34%	20020724	8191.29	488.95	6.35%	37.34%
8	20081022	8519.21	-526.00	-5.82%	74.13%	20080930	10850.66	485.21	4.68%	46.98%
9	19980831	7539.07	-512.61	-6.37%	30.69%	20020729	8711.88	447.49	5.41%	42.13%
10	20081007	9447.11	-508.39	-5.11%	49.67%	20080318	12392.66	420.41	3.51%	24.37%
11	**19871019**	**1738.74**	**-508.00**	**-22.61%**	**82.05%**	20080311	12156.81	416.66	3.55%	21.72%
12	20080915	10917.51	-504.48	-4.42%	27.45%	20081020	9265.43	413.21	4.67%	72.41%
13	20081105	9139.27	-486.01	-5.05%	80.80%	20080918	11019.69	410.03	3.86%	33.78%
14	20080917	10609.66	-449.36	-4.06%	30.64%	20010405	9918.05	402.63	4.23%	34.21%
15	20081120	7552.29	-444.99	-5.56%	67.98%	20081016	8979.26	401.35	4.68%	73.15%
16	20081106	8695.79	-443.48	-4.85%	82.27%	20010418	10615.83	399.10	3.91%	31.94%
17	20010312	10208.25	-436.37	-4.10%	22.24%	20081124	8443.39	396.97	4.93%	72.90%
18	20081119	7997.28	-427.47	-5.07%	68.22%	20080401	12654.36	391.47	3.19%	27.27%
19	20070227	12216.24	-416.02	-3.29%	13.04%	19980908	8020.78	380.48	4.98%	37.79%
20	20081112	8282.66	-411.30	-4.73%	69.95%	20090310	6926.49	379.44	5.80%	40.52%
21	20080606	12209.81	-394.64	-3.13%	17.47%	20021015	8255.68	378.28	4.80%	42.15%
22	20020719	8019.26	-390.23	-4.64%	27.18%	20080919	11388.44	368.75	3.35%	35.80%
23	20070809	13270.68	-387.18	-2.83%	22.19%	20010924	8603.86	368.05	4.47%	36.66%
24	20010920	8376.21	-382.92	-4.37%	31.62%	20081216	8924.14	359.61	4.20%	59.14%
25	20090210	7888.88	-381.99	-4.62%	34.24%	20021001	7938.79	346.86	4.57%	34.78%
26	20001012	10034.58	-379.21	-3.64%	18.24%	20010516	11215.92	342.95	3.15%	20.86%
27	20000307	9796.03	-374.47	-3.68%	25.84%	20001205	10898.72	338.62	3.21%	20.86%
28	20080922	11015.69	-372.75	-3.27%	37.57%	19971028	7498.32	337.17	4.71%	34.17%
29	20080205	12265.13	-370.03	-2.93%	24.39%	20070918	13739.39	335.97	2.51%	17.82%
30	20081006	9955.50	-369.88	-3.58%	48.57%	20080805	11615.77	331.62	2.94%	25.32%

Looking at the percent change of stock indexes is relevant . . .

- This measures the rate of return on the investment
  - i.e., how many more dollars you would have at the end of the day if you invested $100 at the beginning of the day
- The sixty largest percent changes in the DJIA (or the S&P 500) have been before the last 12 years
  - The only exceptions among these sixty days are after 9/11/2001, and nine days in 2008-2009

Daily Returns to the Dow Jones Industrial Average, 1893-2009



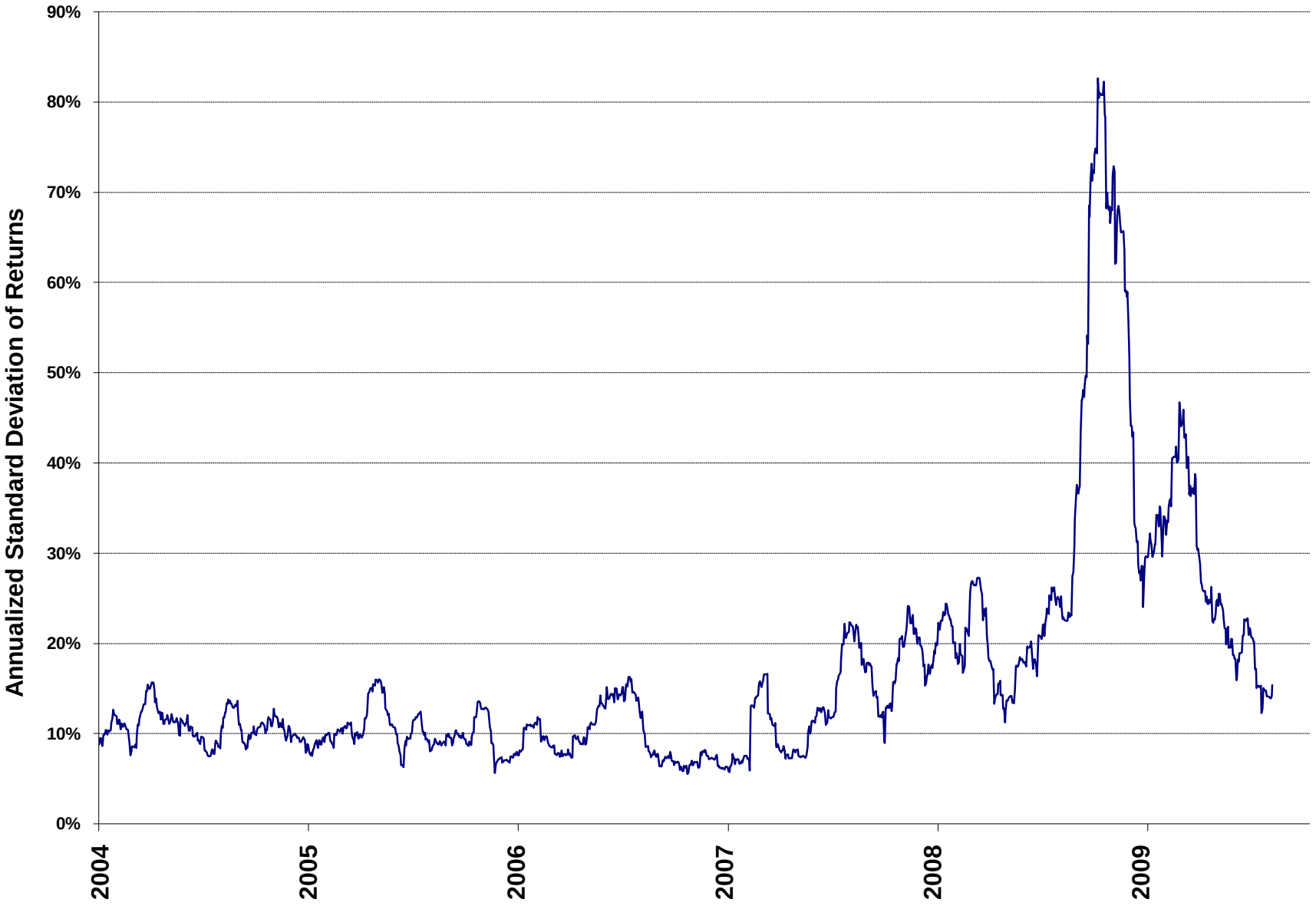
The Thirty Largest Daily Percent Increases and Decreases in the Dow Jones Industrial Index, 1885-2009 (T=34,347)

		DJIA	Chg	Ret	Std		DJIA	Chg	Ret	Std
1	19871019	1738.74	-508.00	-22.61%	82.05%	19330315	62.10	8.26	15.34%	67.27%
2	19291028	260.64	-38.33	-12.82%	57.25%	19311006	99.34	12.86	14.87%	76.05%
3	19291029	230.07	-30.57	-11.73%	67.23%	19291030	258.47	28.40	12.34%	82.88%
4	19291106	232.13	-25.55	-9.92%	89.96%	19320921	75.16	7.67	11.36%	60.42%
5	18991218	42.69	-4.08	-8.72%	39.27%	**20081013**	**9387.61**	**936.42**	**11.08%**	**68.53%**
6	18951220	28.77	-2.68	-8.51%	31.24%	**20081028**	**9065.12**	**889.35**	**10.88%**	**82.63%**
7	19320812	63.11	-5.79	-8.40%	58.44%	19871021	2027.85	186.84	10.15%	93.80%
8	19070314	55.84	-5.05	-8.29%	32.67%	19320803	58.22	5.06	9.52%	47.49%
9	19871026	1793.93	-156.83	-8.04%	97.05%	19320211	78.60	6.80	9.47%	48.33%
10	**20081015**	**8577.91**	**-733.08**	**-7.87%**	**71.30%**	19291114	217.28	18.59	9.36%	100.97%
11	19330721	88.71	-7.55	-7.84%	45.61%	19311218	80.69	6.90	9.35%	55.84%
12	19371018	125.73	-10.57	-7.75%	39.81%	19320213	85.82	7.22	9.19%	58.11%
13	**20081201**	**8149.09**	**-679.95**	**-7.70%**	**67.07%**	19320506	59.01	4.91	9.08%	53.56%
14	18930726	24.76	-1.98	-7.39%	35.21%	19330419	68.31	5.66	9.03%	43.44%
15	**20081009**	**8579.19**	**-678.91**	**-7.33%**	**54.10%**	19311008	105.79	8.47	8.70%	82.72%
16	19170201	88.52	-6.91	-7.24%	29.02%	19320610	48.94	3.62	7.99%	58.15%
17	19971027	7161.15	-554.26	-7.18%	29.34%	19390905	148.12	10.03	7.26%	34.25%
18	19321005	66.07	-5.09	-7.15%	65.12%	19310603	130.37	8.67	7.12%	36.25%
19	**20010917**	**8920.70**	**-684.81**	**-7.13%**	**29.12%**	19320106	76.31	5.07	7.12%	57.97%
20	19310924	107.79	-8.20	-7.07%	42.63%	**20090323**	**7775.86**	**497.48**	**6.84%**	**46.70%**
21	19330720	96.26	-7.32	-7.07%	38.29%	19321014	63.84	4.08	6.83%	70.53%
22	**20080929**	**10365.45**	**-777.68**	**-6.98%**	**43.54%**	19070315	59.58	3.74	6.69%	41.97%
23	19140730	52.32	-3.88	-6.91%	26.69%	**20081113**	**8835.25**	**552.59**	**6.67%**	**68.67%**
24	19891013	2569.26	-190.58	-6.91%	25.89%	19310620	138.96	8.65	6.64%	48.57%
25	19880108	1911.31	-140.58	-6.85%	38.23%	19330724	94.28	5.86	6.63%	51.72%
26	19291111	220.39	-16.14	-6.82%	91.60%	18930727	26.40	1.64	6.63%	44.00%
27	19400514	128.27	-9.36	-6.80%	29.89%	**20081121**	**8046.42**	**494.13**	**6.54%**	**71.80%**
28	19311005	86.48	-6.29	-6.78%	49.77%	18930802	27.85	1.71	6.54%	51.37%
29	19400521	114.13	-8.30	-6.78%	38.97%	19330619	95.99	5.76	6.38%	40.46%
30	19340726	85.51	-6.06	-6.62%	29.40%	19010510	52.50	3.14	6.37%	37.02%

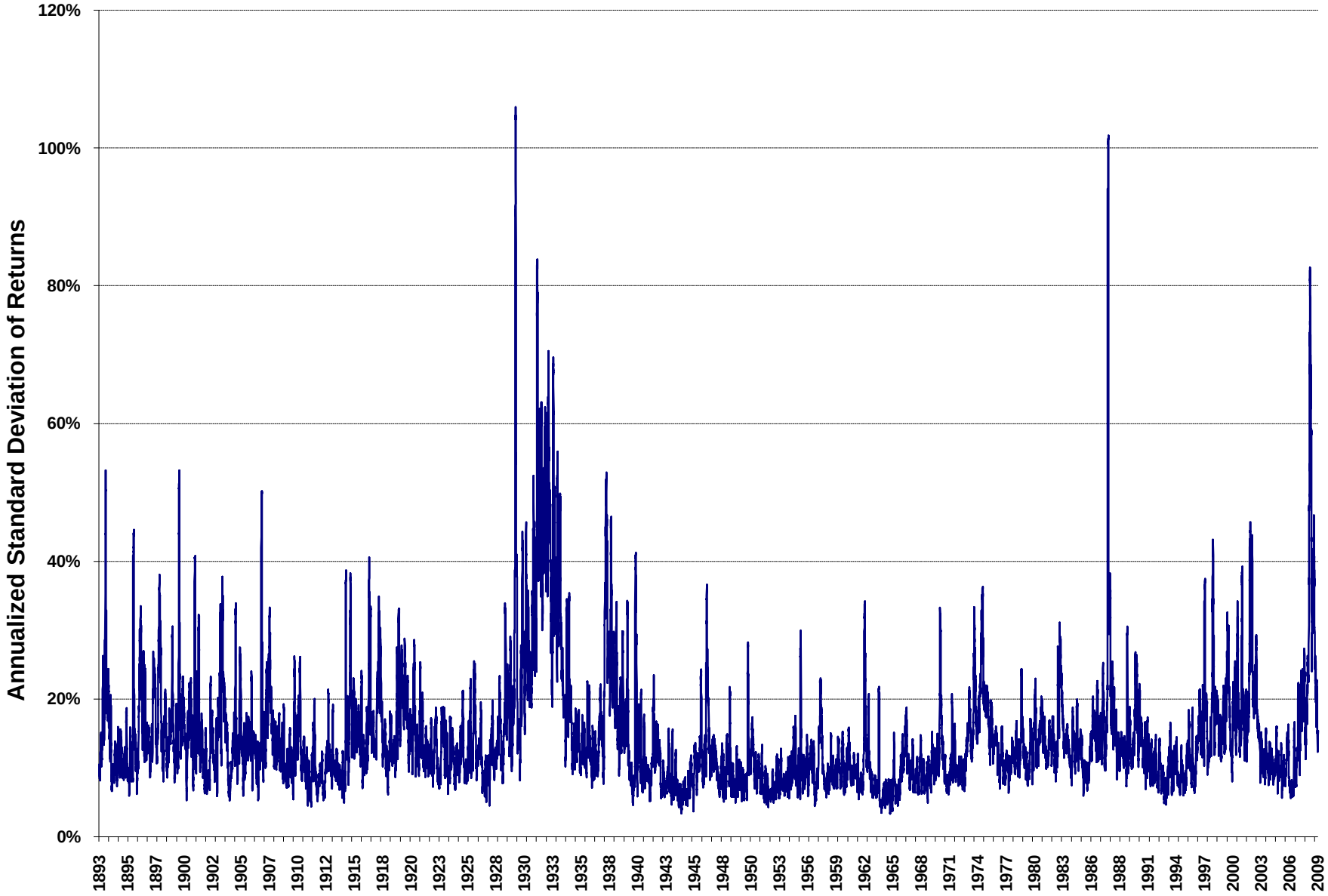
How to lie with statistics . . . - focus on very recent history

- Newspapers often focus on the last few years in discussing current conditions
  - On this basis, people would think stock volatility is unbelievably high in the past year or so . . .
  - This is misleading when viewed from the perspective on the longer history we have available to us
  - Compare the plots of rolling standard deviations from 2004-2009 versus the plot from 1893-2009 . . .
  - Good news is that things seem to have settled down a bit now (compared to 12 months ago)

Volatility of the Dow Jones Industrial Average, 2004-2009



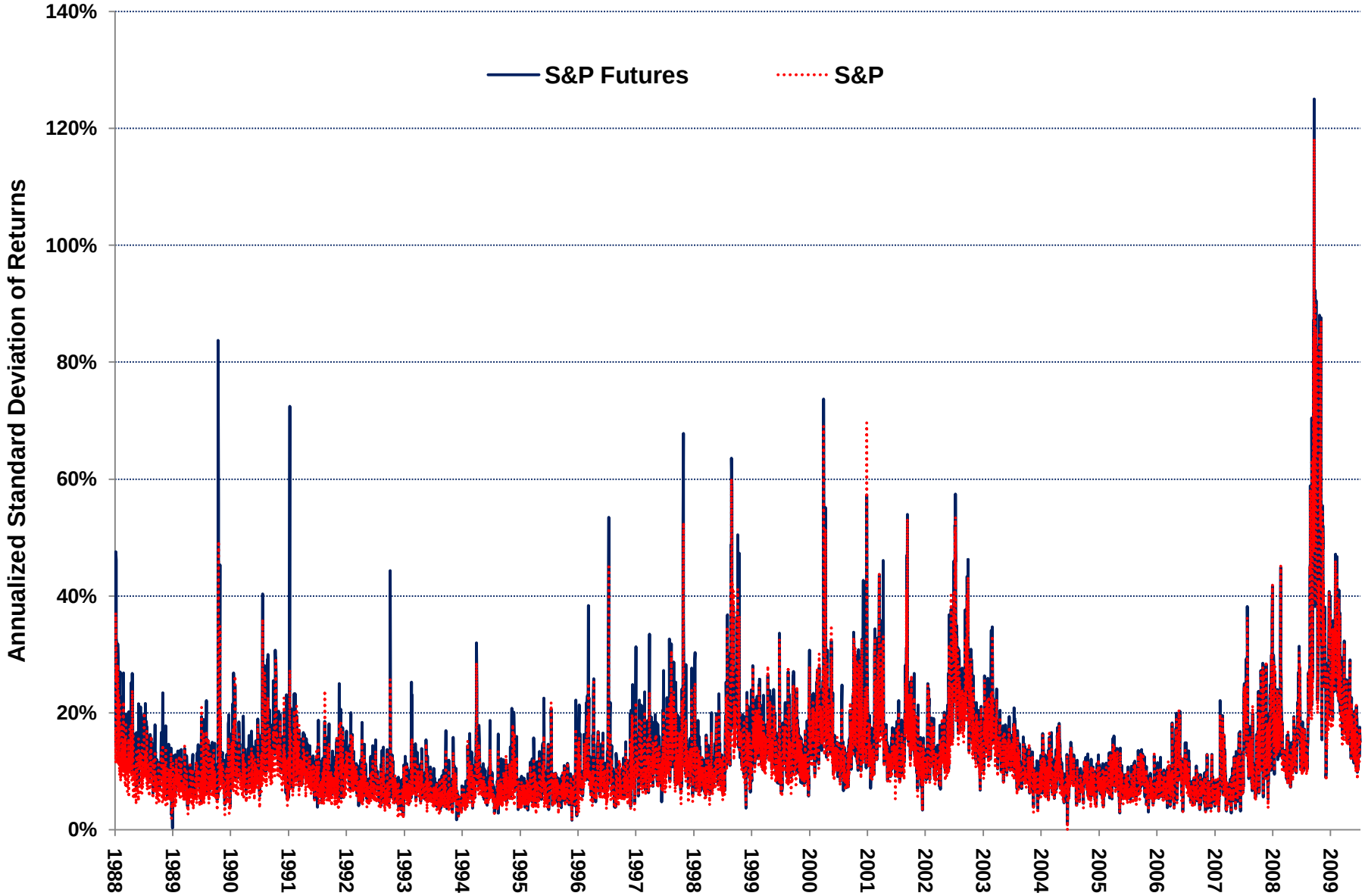
Volatility of the Dow Jones Industrial Average, 1893-2009



Similar conclusions from recent intra-day data: 15-minute returns to the S&P 500 and S&P futures

- These estimates of annualized volatility are independent from day-to-day
  - Not overlapping
  - Volatility was very high in late 2008, but now looks fairly “normal”
  - Focusing on the post-2004 period is misleading

Volatility of the S&P 500 and S&P Futures, Based on Intraday 15-minute Returns, 1988-2009



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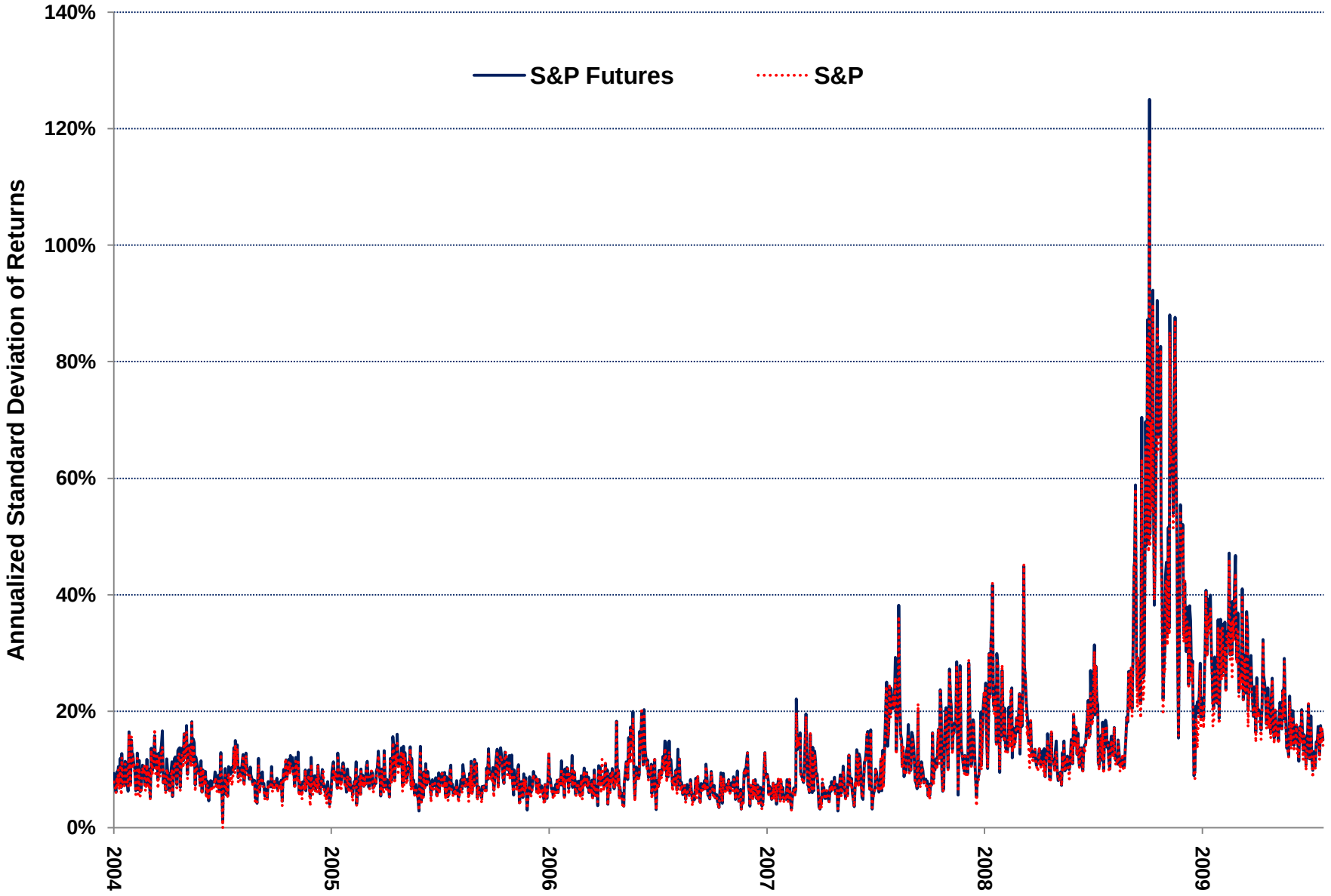
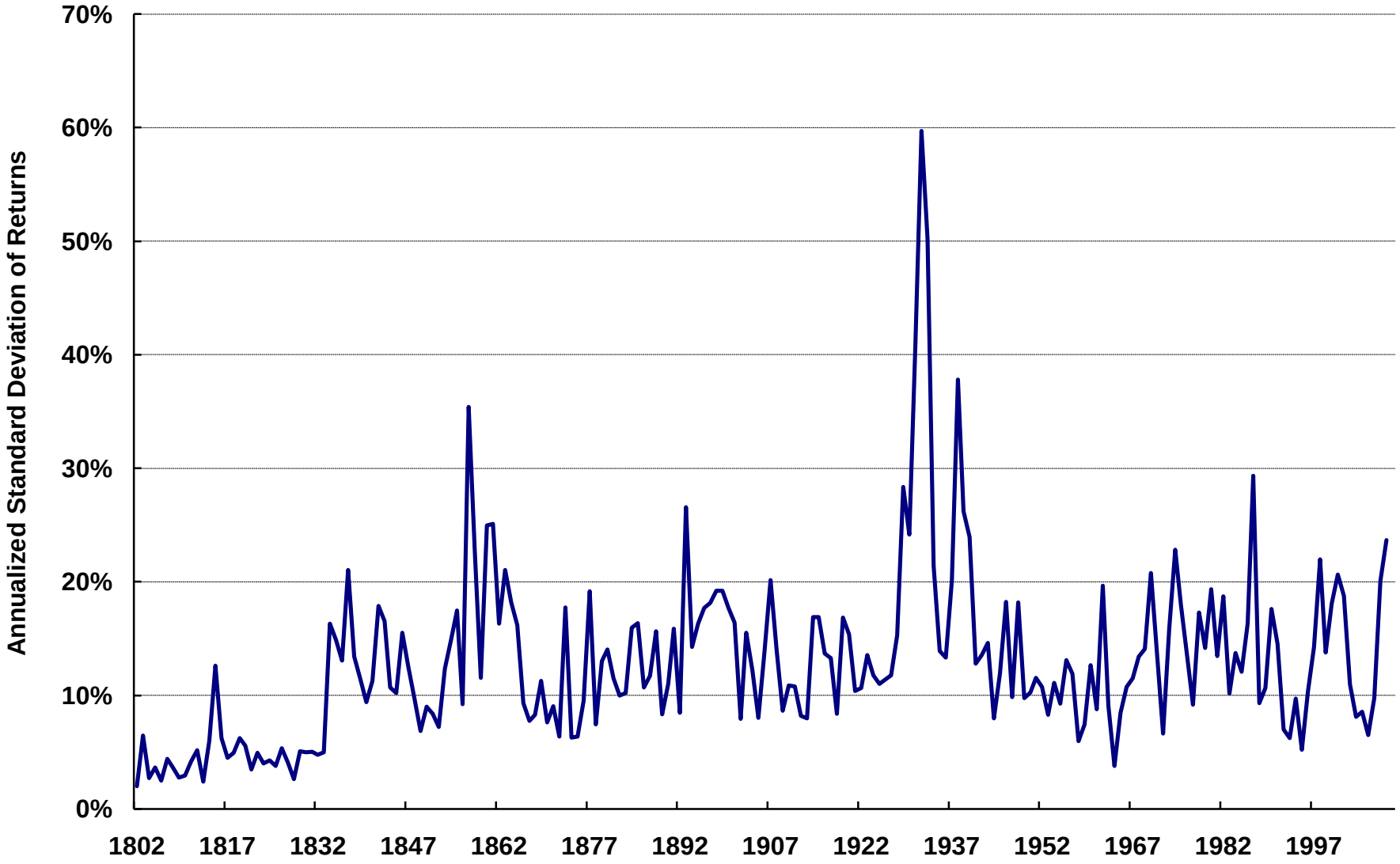


Stylized Facts/Questions: A very long-term view!

- Market-level volatility has been remarkably stable over time
  - Data back to 1802, covers many wars, financial crises, depressions/recessions
  - Also, major changes in the composition of the US economy
    - Mainly banks, insurance companies, canals in early 1800s
    - Railroads started being important after 1834
    - Great Depression is the most notable period of prolonged high volatility

Annualized Standard Deviations of U.S. Stock Returns from Monthly Returns in the Year, 1802-2009



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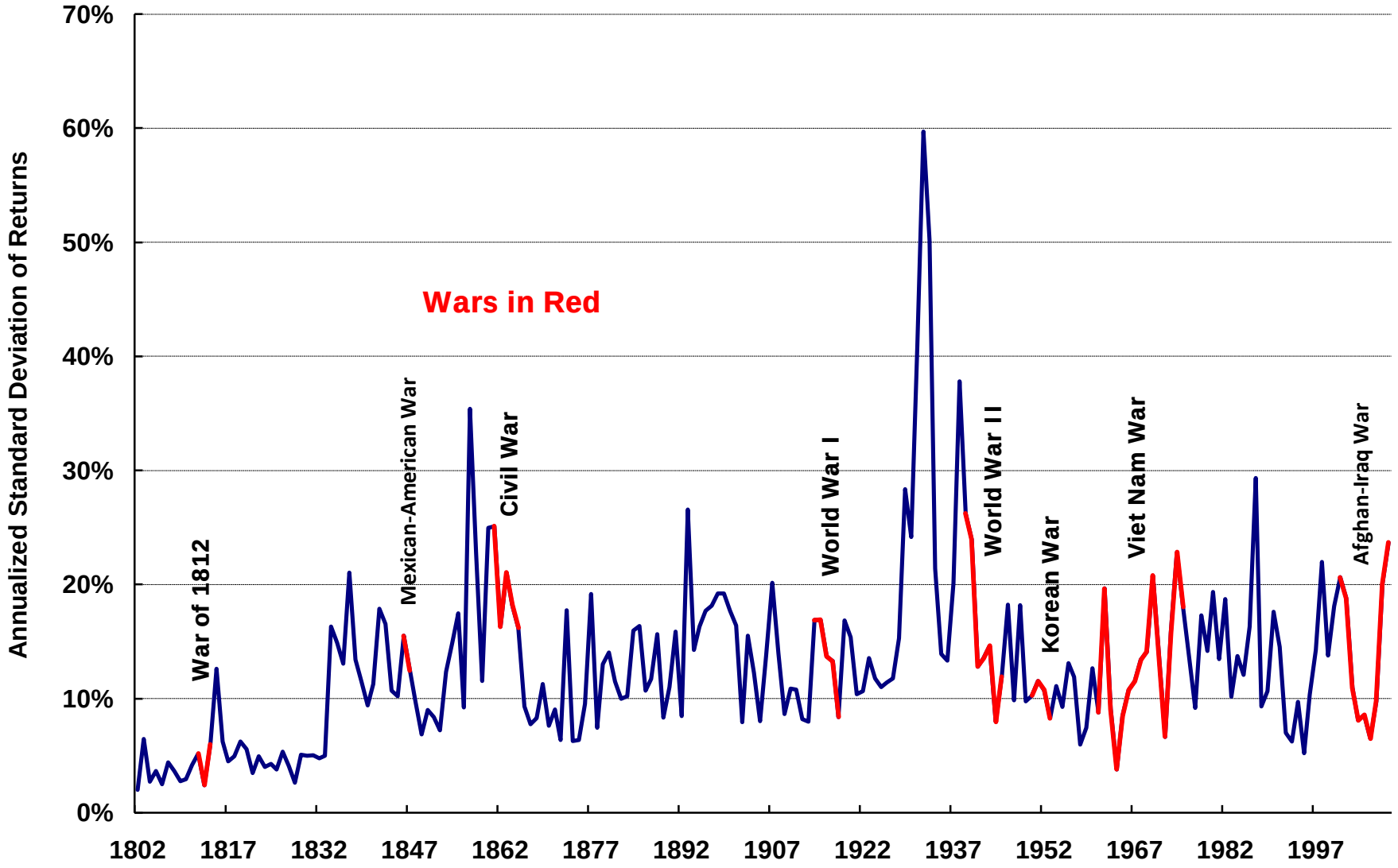

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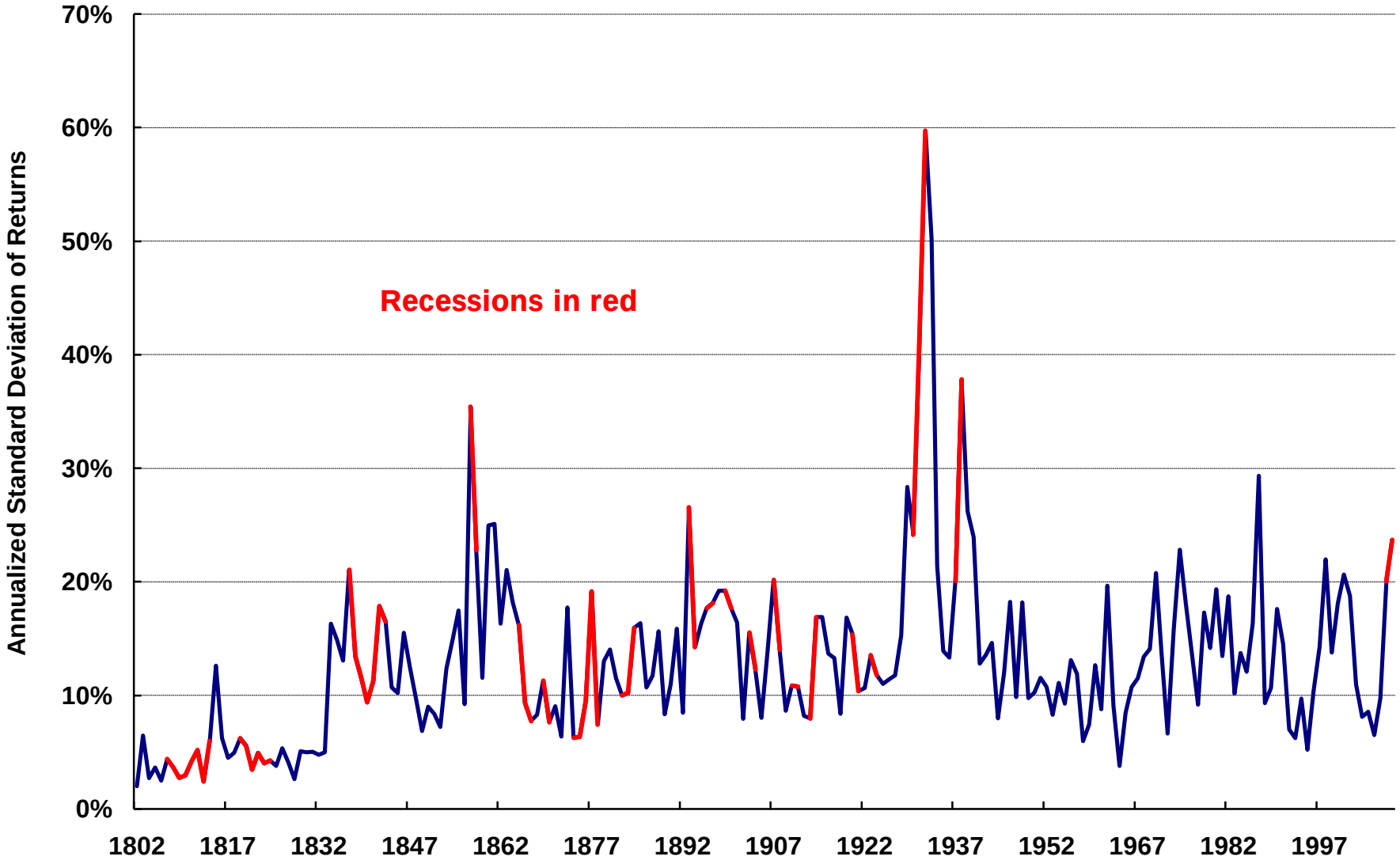
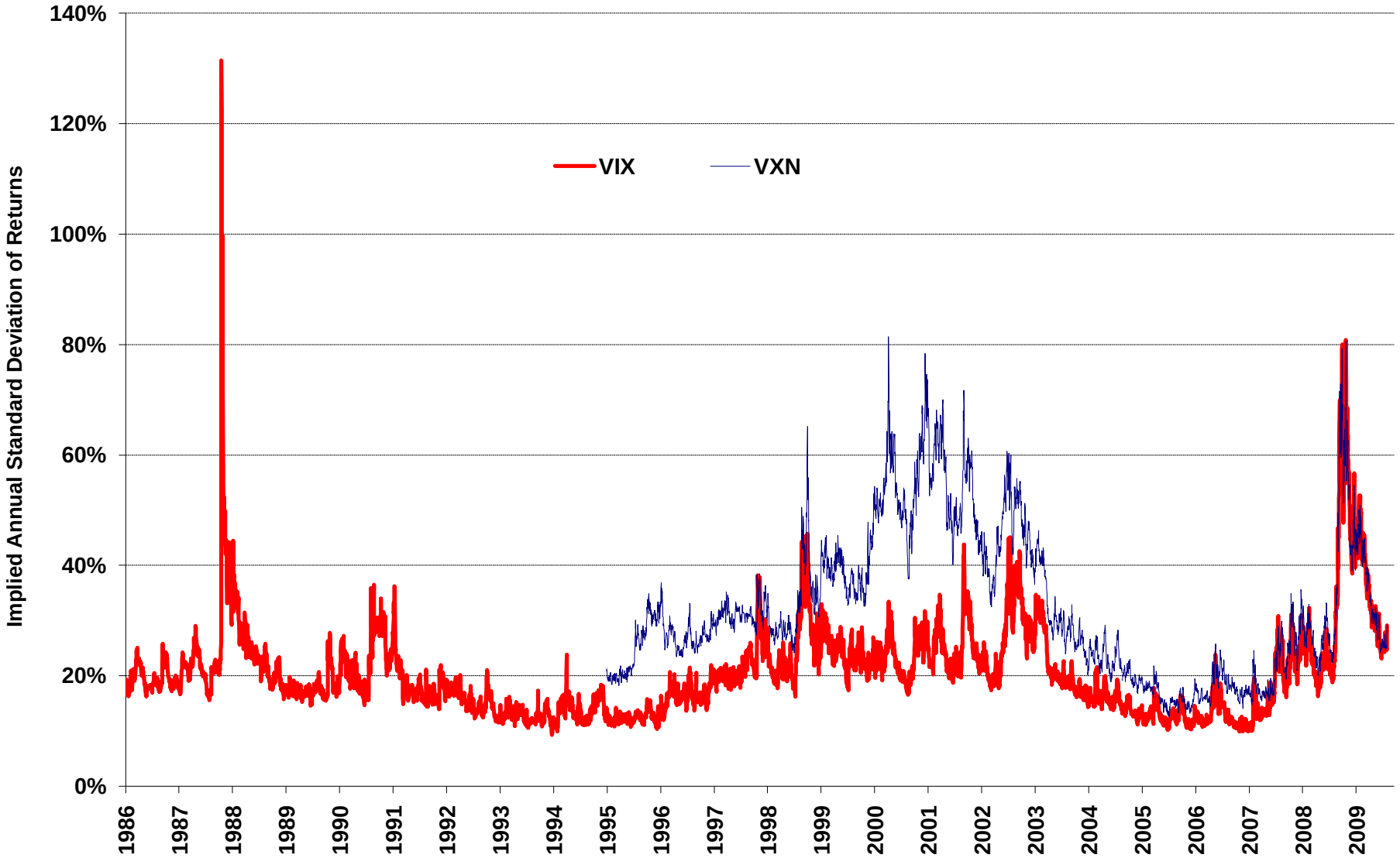


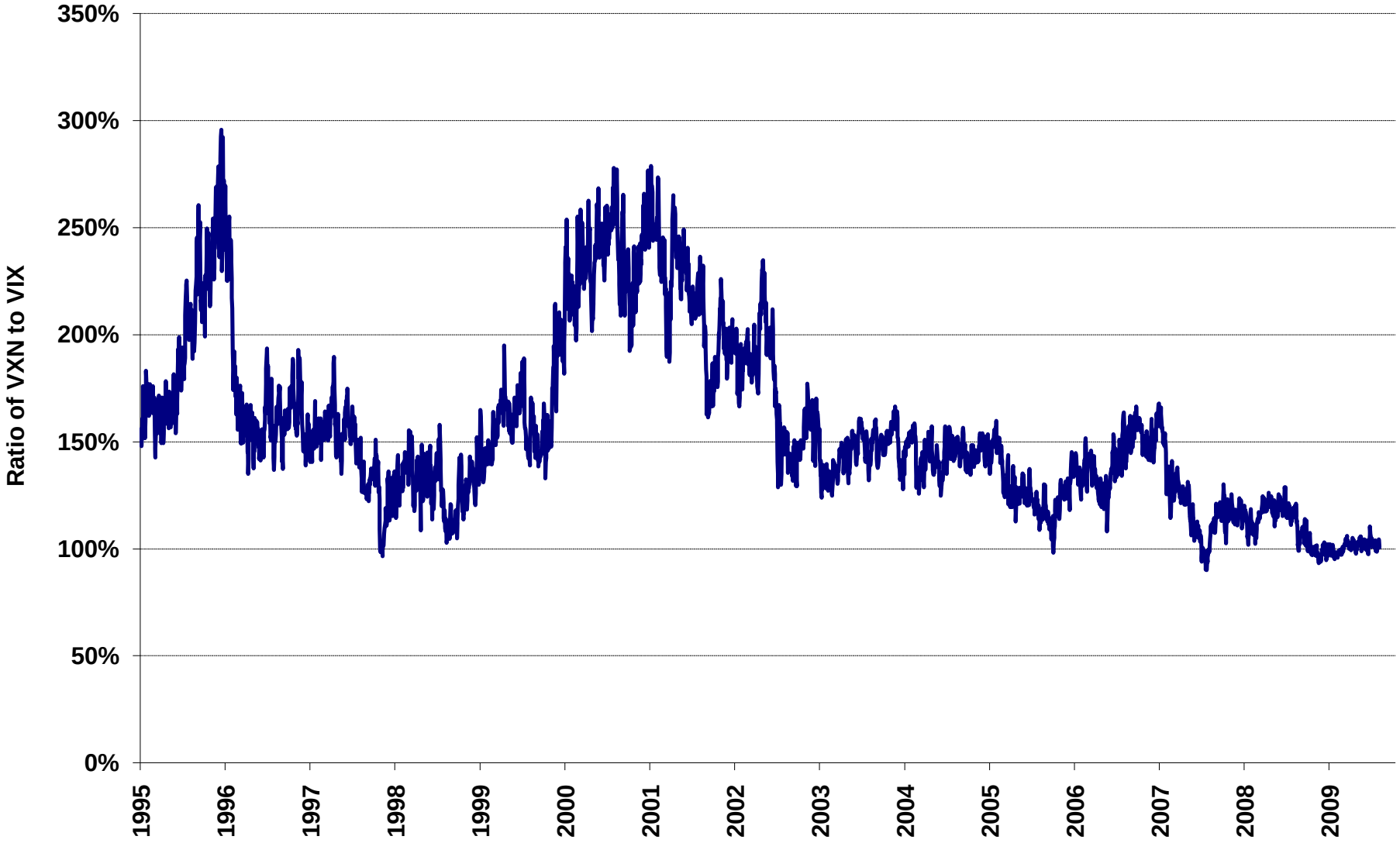
Implied Volatility: S&P vs. Nasdaq

- Next figure shows the implied volatility series published by CBOE with ticker symbols VIX (S&P) and VXN (Nasdaq)
  - VXN is much higher, especially in 2000-2002; similar since mid-2007
  - These measures represent forecasts of future volatility (covering the span of the underlying index options, usually about a month)

Implied Volatility for S&P 500 (VIX) and Nasdaq 100 Portfolio (VXN), Annualized Standard Deviation of Returns, 1986-2009



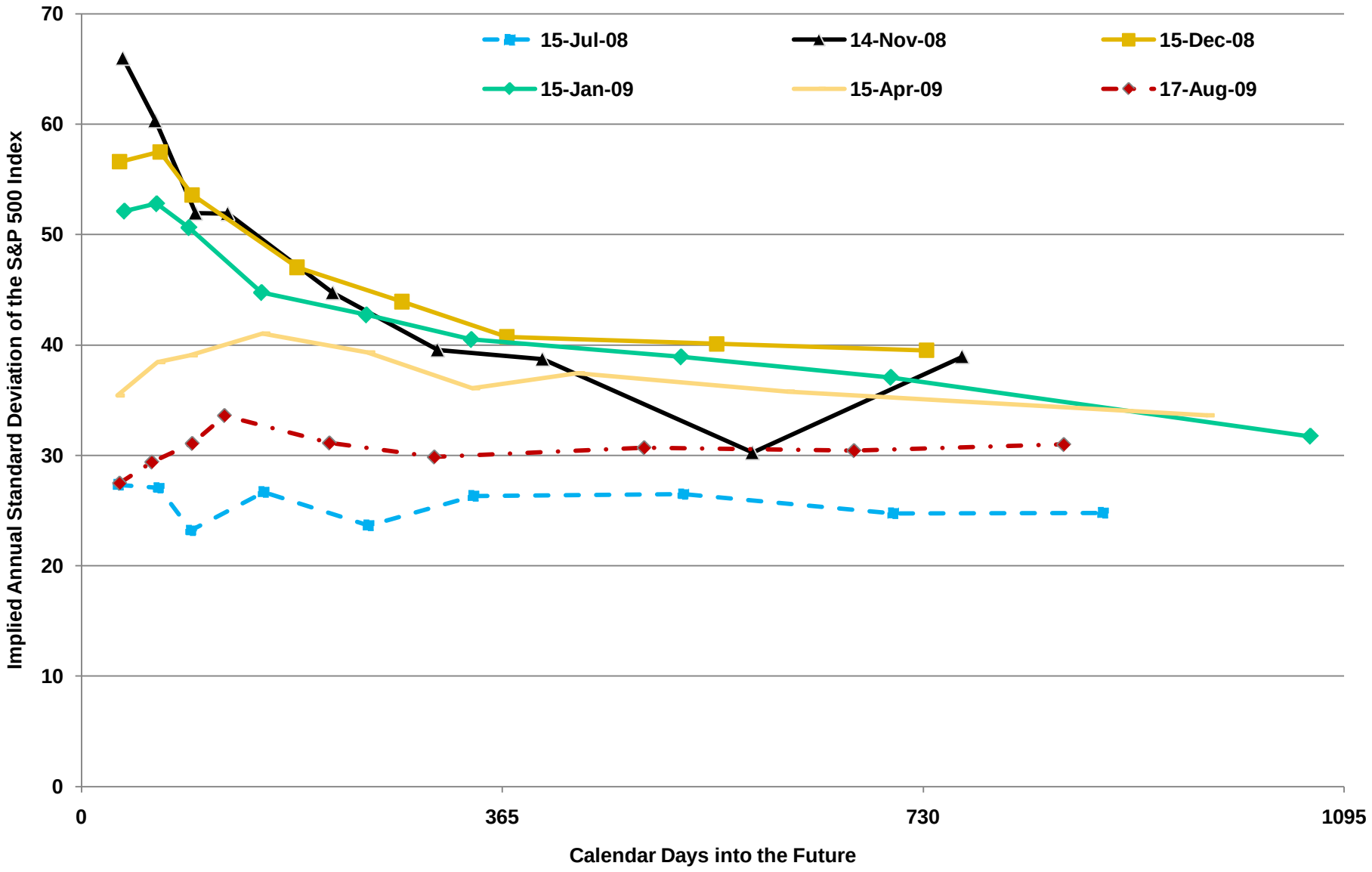
Implied Volatility for Nasdaq 100 Portfolio (VXN) Relative to S&P 500 (VIX), Annualized Standard Deviation of Returns, 1995-2009



Term structure of implied volatility: Things will settle down . . .

- Recently the CBOE has started to report implied volatility for the S&P 500 for horizons longer then 30 days
  - Looking at the term structures from 2000-2009, until very recently they were pretty flat (i.e., similar forecasts for all horizons)
  - The big spikes in volatility starting last Fall have led to a sharply declining forecast of future volatility
  - Things are now back to more normal patterns

Forward Structure of Implied S&P Volatility, 2008-2009

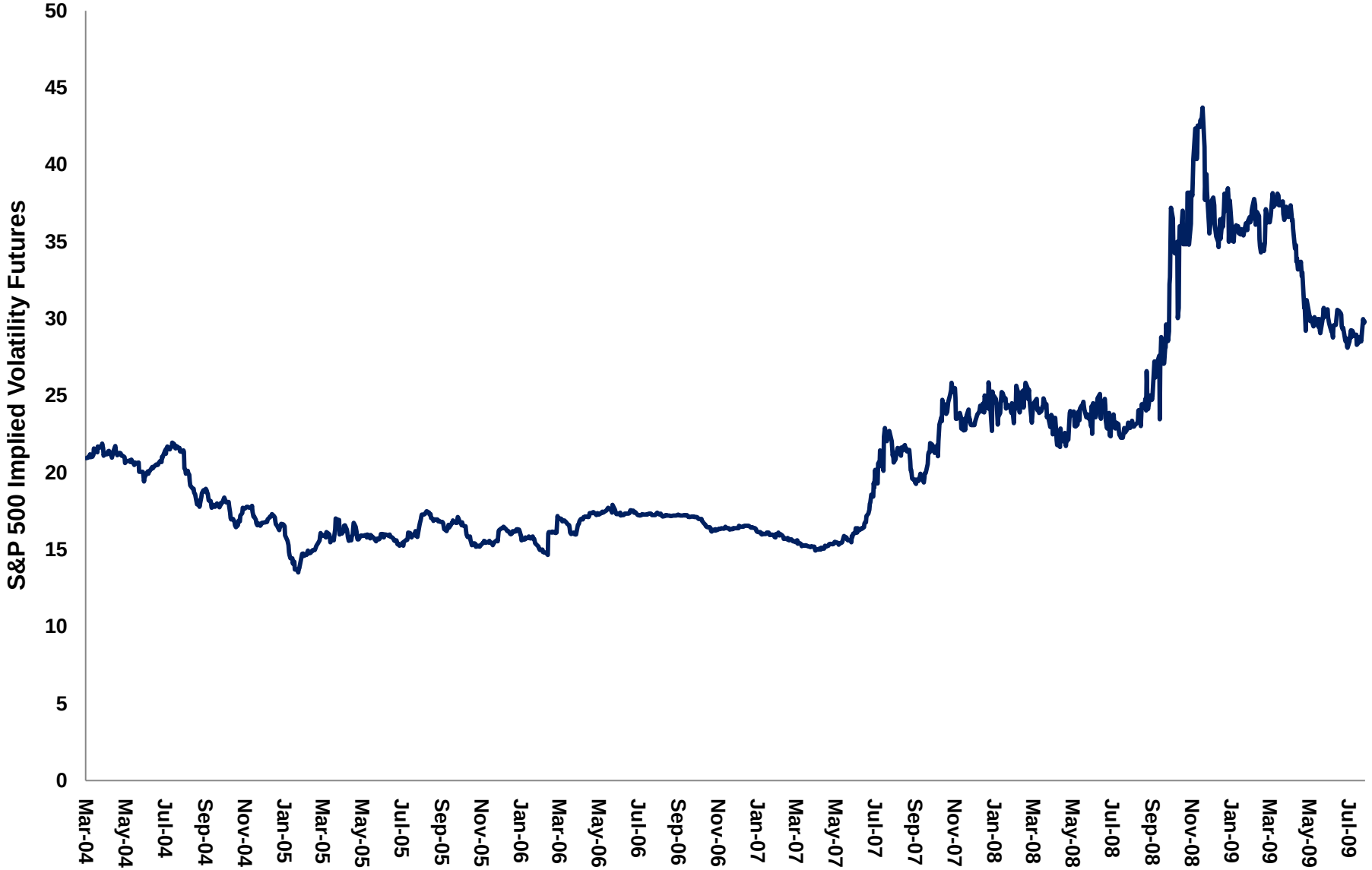


http://www.cboe.com/micro/vix/vixtermstructure.aspx

The CBOE now trades a futures contract on VIX

- Looking at the longest future maturity (typically about 9-10 months)
  - Futures value of VIX peaks at 43% in mid-December 2008, and now has returned to around 30%
  - Even at the worst of the liquidity crisis, traders were not expecting the spike in volatility to last long or be as bad as was briefly in the Fall of 2008

Longest Maturity S&P Volatility Futures Value, March 2004 - August, 2009 (average maturity = 0.86 year)



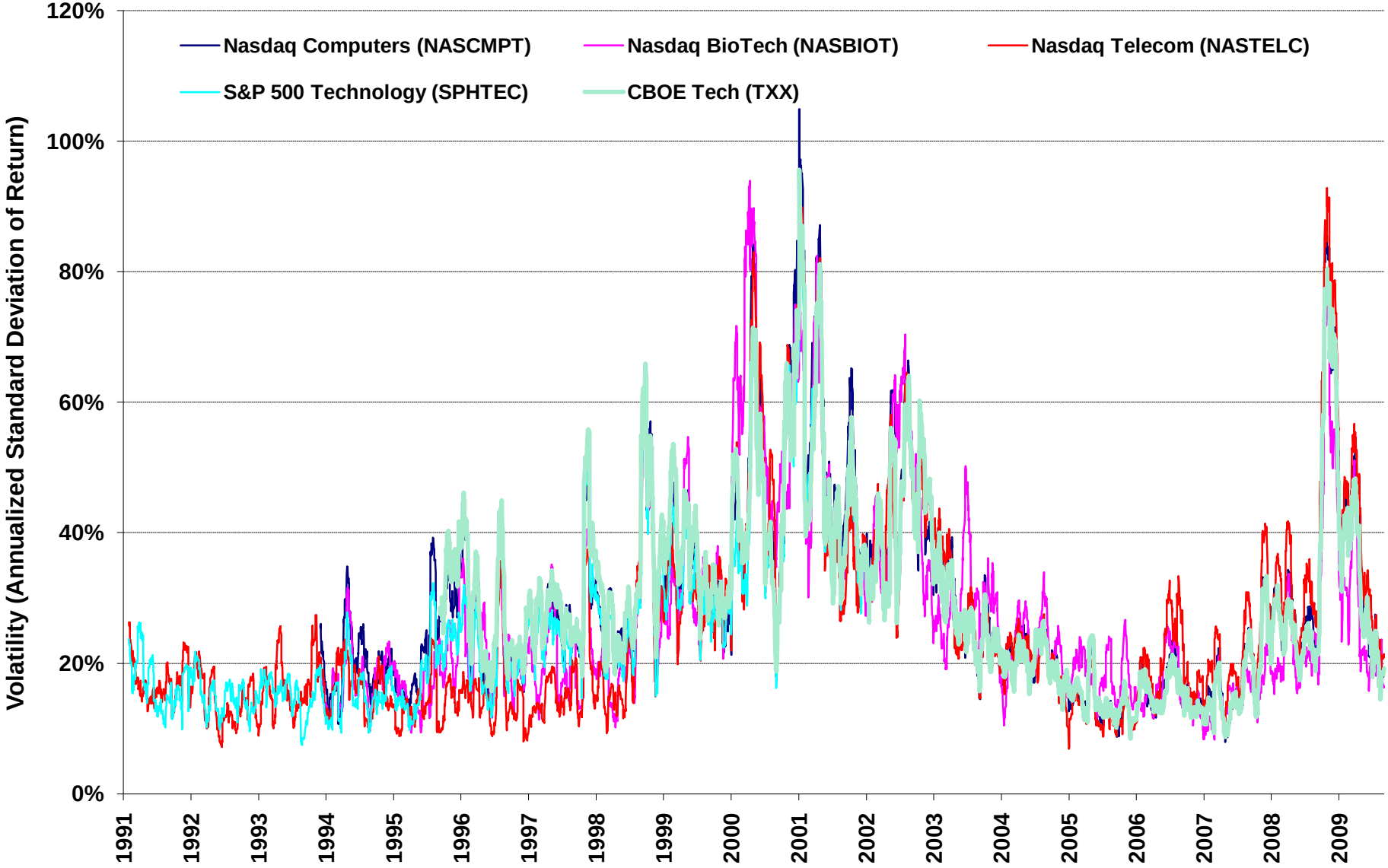
Prior Issues: Technology Bubble?

- 2000-2002 was a period of high volatility for Nasdaq/technology stocks
  - This seems to have returned to more normal levels in the last couple of years
  - High volatility was primarily in technology stocks, independent of firm size, exchange listing, or age of the firm
  - Not limited to “DOT.COM” stocks

Technology Portfolios

- Next figure shows historical volatility for:
  - S&P Technology portfolio, Nasdaq Computer, Biotech, and Telecom, and the CBOE Technology portfolios
    - They all move together, increasing substantially since mid-1998
    - Decreasing in 2003
    - Not increasing as much lately

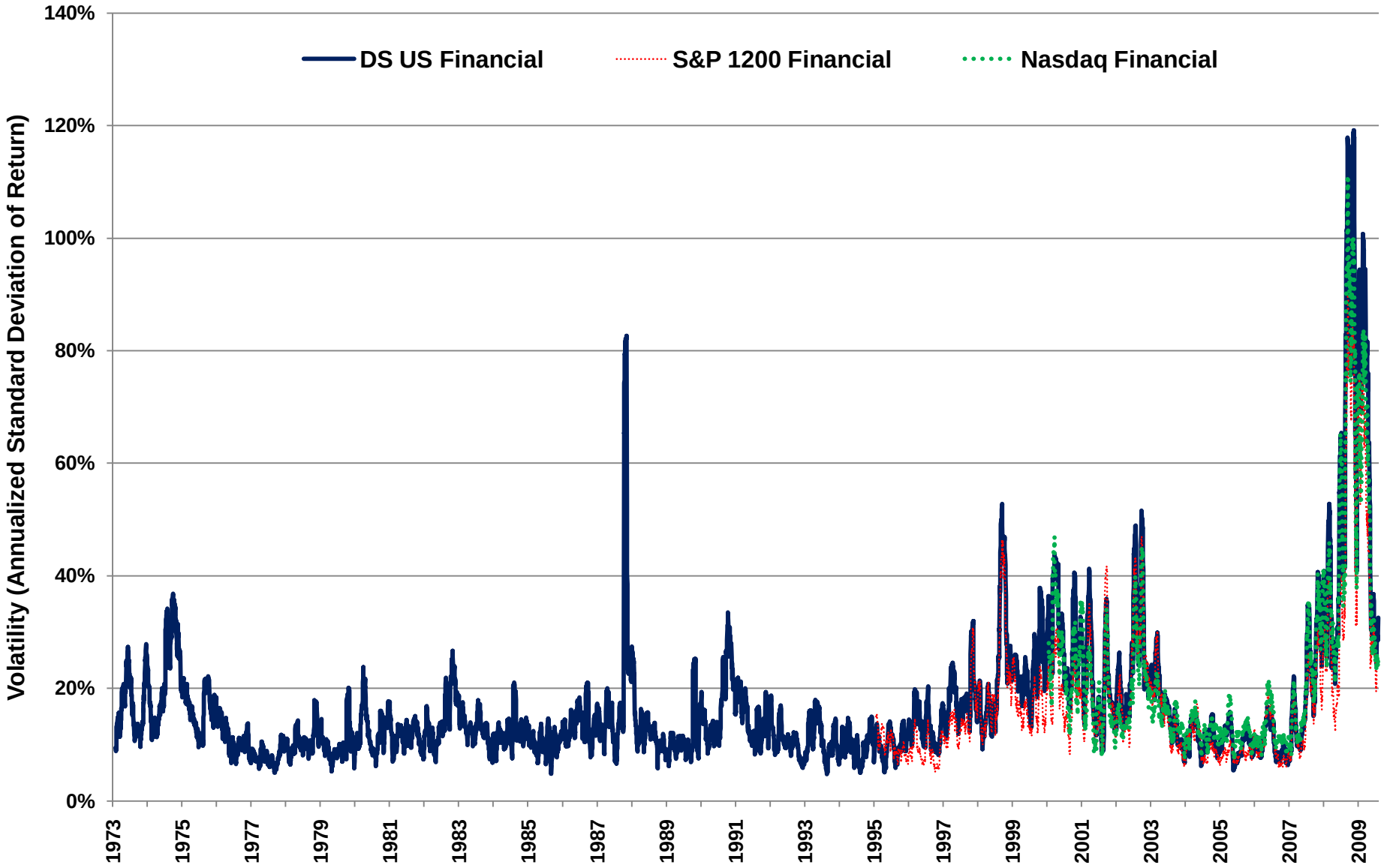
Volatility for Several Indexes of Technology Stocks, Annualized Standard Deviation of Returns, 1991-2009



Finance Industry Portfolios

- Next figure shows historical volatility for:
  - Nasdaq Financial portfolio, the S&P 1200 Financial portfolio, and the Datastream US Financial portfolio, since 1973
    - They all move together, increasing modestly during the Technology “bubble” from 1998-2002
    - Increased substantially in 2008-2009 during the liquidity crisis

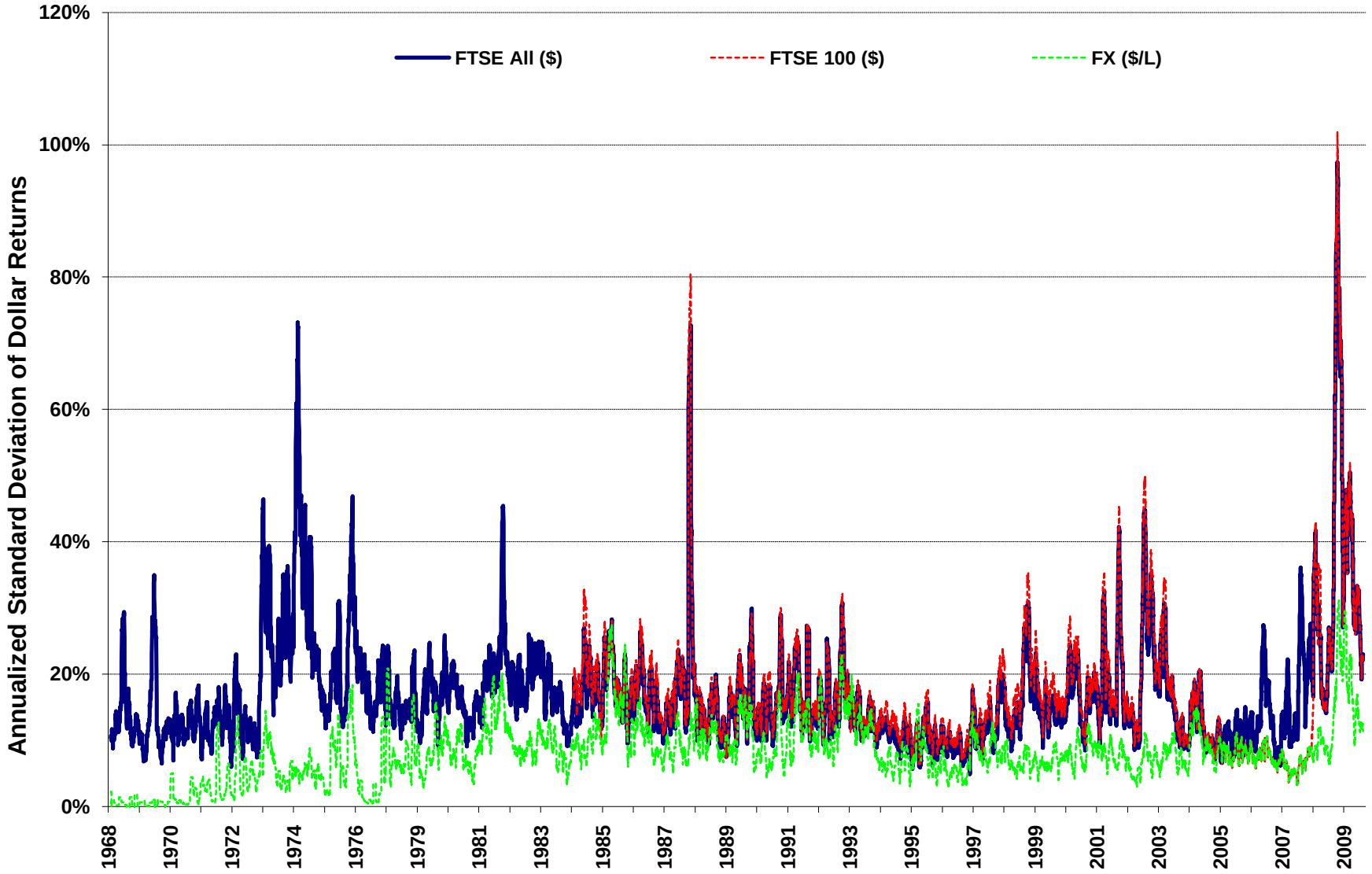
Volatility for Several Indexes of Financial Stocks, Annualized Standard Deviation of Returns, 1973-2009



Foreign Markets – FTSE (UK)

- Volatility now is similar to late 90's early 2000's, and similar to US levels
- Also similar to 1973-74 (first OPEC crisis)
- Exchange rate volatility is higher recently, but small compared with stock volatility

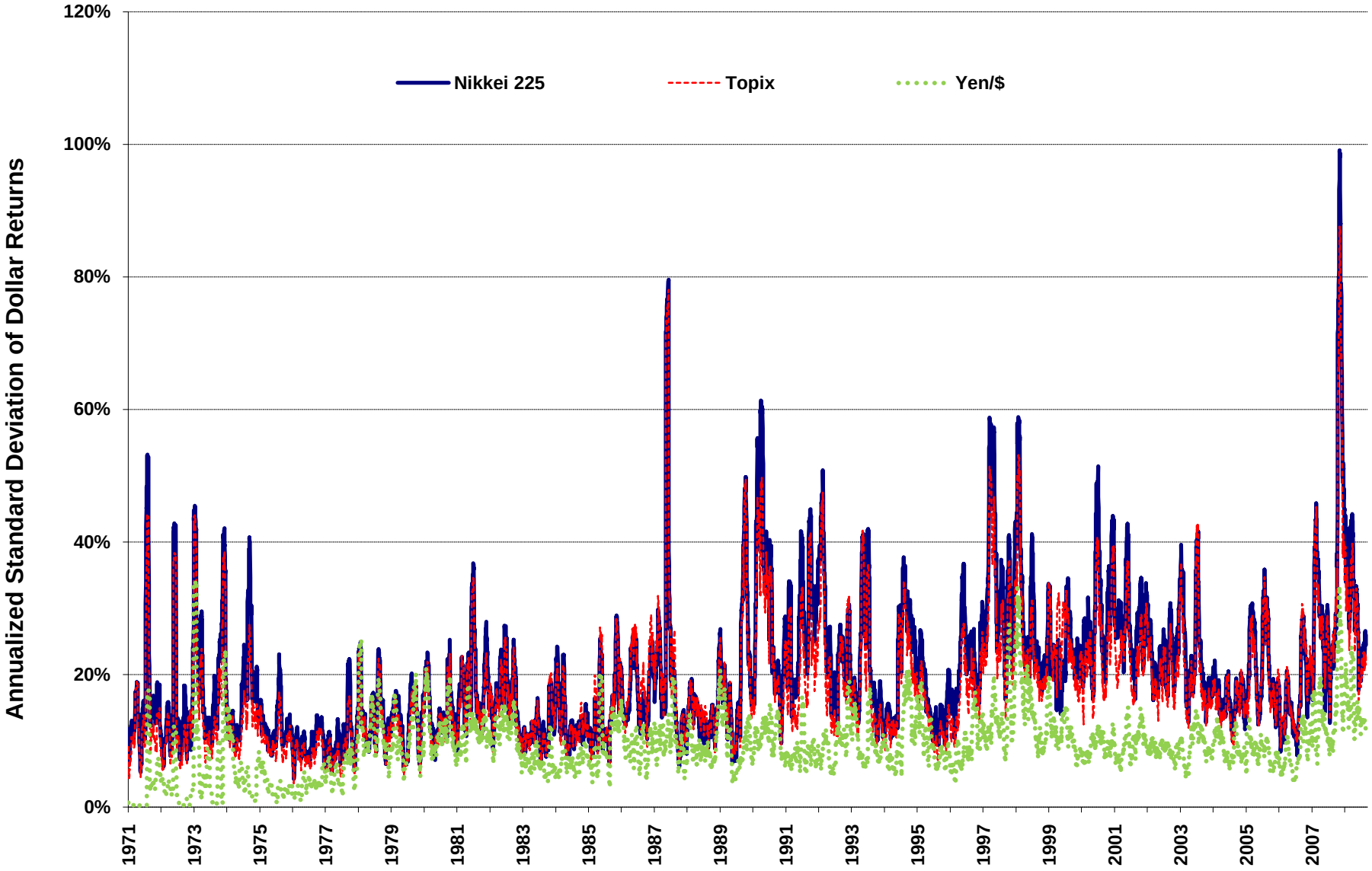
Dollar Volatility of FTSE All Shares and FTSE 100 Indexes, 1968-2009

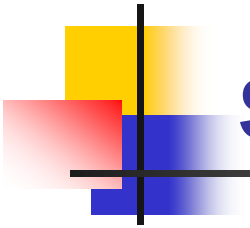


Foreign Markets – Nikkei 225 and Topix (Japan)

- Volatility now is similar to 1989-2003, and similar to US levels
- Also similar to 1973-74 (first OPEC crisis)
- Exchange rate volatility is higher recently, but small compared with stock volatility

Dollar Volatility of Nikkei 225 and Topix Indexes, 1950-2009





Summary

- Market-level volatility often rises after prices fall
  - Recent poor performance of the market is consistent with the higher levels of volatility [counter-cyclical]
  - Inflation of index levels exaggerate perceptions of increased volatility

Should Someone Try to Lower Volatility? If So, How?

- Margin requirements?
- Regulation of trading?
- Taxes on Trading?