

# Mean Reversion Expectations and the 1987 Stock Market Crash: An Empirical Investigation

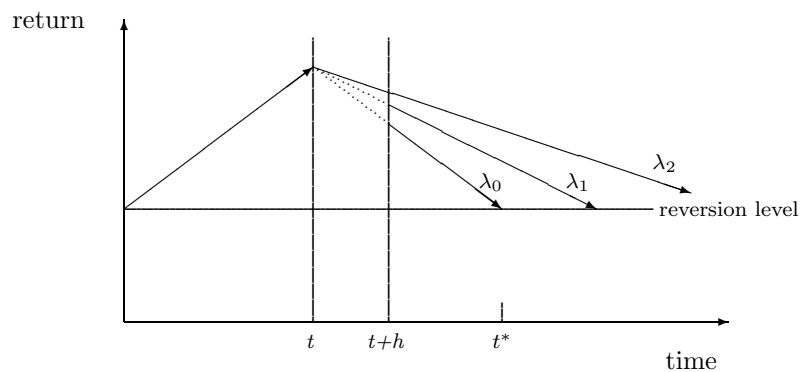
Eric Hillebrand  
Department of Economics  
Louisiana State University

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# Mean Reversion Expectations

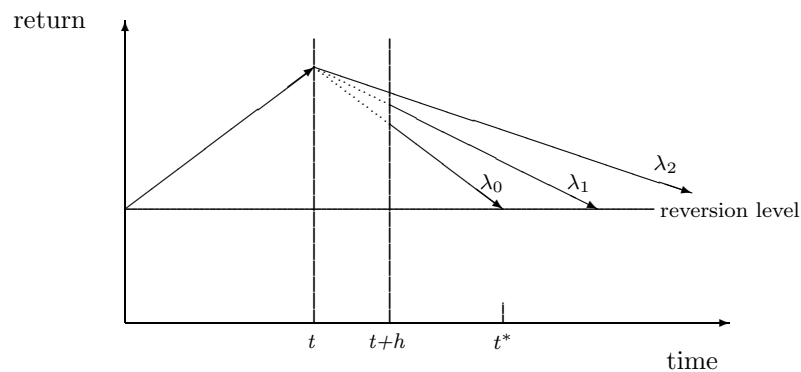
- In a market with mean reversion in stock returns, investors have expectations of the mean reversion speed.
- Positive jump: Investor waits some time  $h$  to look at the market and form expectations.
- Mean reversion expectations of other investors must be inferred from sales.
- Some investors act autonomously.



Black (1988), DeBondt/Thaler (1985), Fama/ French (1988),  
Poterba/Summers (1988).

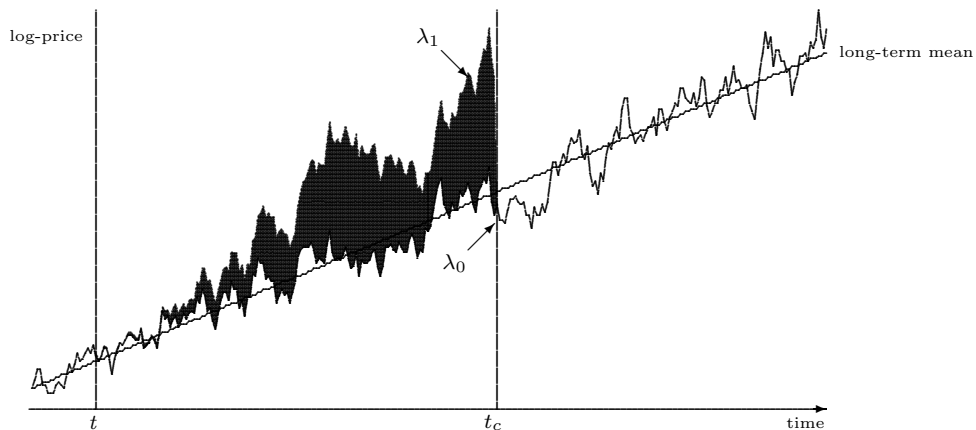
# Mean Reversion Illusion

- Assume that most investors wait.
- They mistake a minority for the market.
- Majority adopts mean reversion expectations of minority.
- Minority may not even expect a slower reversion but can be hedged against a faster reversion.



# Mean Reversion Disillusion and Oct 19, 1987

- Two possibilities of disillusion:
  1. Disclosure of hedge position.
  2. Majority becomes aware of being the majority.
- 1987: Portfolio insurance companies provided undisclosed hedging.
- From Wednesday, Oct 14, to Friday, Oct 16, U.S. market lost about 10 percent. Portfolio insurance position became known. (Brady-Report, p 29 and III-16)



Jacklin/Kleidon/Pfleiderer (1992)

# Estimation of Mean Reversion Disillusion in the 1987 Case

- Model: (Vasicek 1977)

$$d \log S_t = \mu dt + \lambda (\log S_0 e^{\mu t} - \log S_t) dt + \sigma dW_t,$$

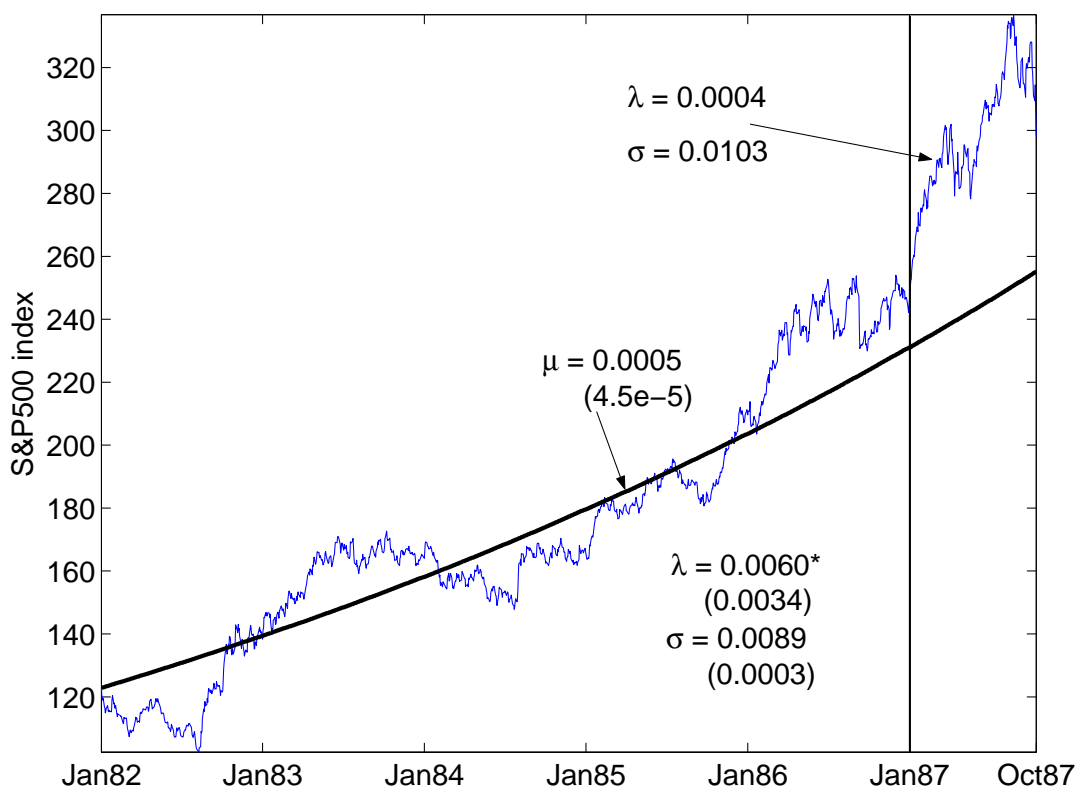
$$\begin{aligned} & \log S_{t+1} - \log S_t \\ & \sim \mathcal{N}(\mu + \lambda (\log S_0 e^{\mu t} - \log S_t), \sigma^2). \end{aligned}$$

- Data: daily S&P500.

$n$	$n$ days before Oct. 16, 1987			$n$ days after Oct. 26, 1987		
	$\hat{\mu}$	$\hat{\lambda}$	$\hat{\sigma}$	$\hat{\mu}$	$\hat{\lambda}$	$\hat{\sigma}$
100	0.000483 (0.000613)	<b>0.010565</b> (0.011637)	0.009632 (0.000827)	0.001401 (0.000114)	<b>0.16636**</b> (0.061999)	0.016239 (0.001703)
200	0.001172 (0.000401)	<b>0.005814</b> (0.005729)	0.010373 (0.000581)	0.000851 (7.6e-5)	<b>0.077153*</b> (0.03205)	0.013997 (0.001075)
300	0.001004 (0.000133)	<b>0.024993</b> (0.015156)	0.010127 (0.000592)	0.000683 (4.9e-5)	<b>0.052885*</b> (0.021259)	0.012292 (0.000859)
400	0.000672 (0.000110)	<b>0.016753</b> (0.008603)	0.009907 (0.000496)	0.000713 (3.1e-5)	<b>0.052938**</b> (0.019714)	0.011204 (0.000722)
500	0.001062 (0.000103)	<b>0.013118</b> (0.008098)	0.009516 (0.000425)	0.000769 (2.9e-5)	<b>0.044117**</b> (0.014459)	0.010935 (0.000699)
600	0.000834 (6.4e-5)	<b>0.015902*</b> (0.006800)	0.009034 (0.000379)	0.000715 (2.8e-5)	<b>0.033246**</b> (0.011698)	0.01056 (0.000614)
700	0.000951 (4.7e-5)	<b>0.017962*</b> (0.007320)	0.008701 (0.000344)	0.000663 (3.2e-5)	<b>0.023374*</b> (0.009914)	0.010297 (0.000554)
800	0.000801 (4.3e-5)	<b>0.015205*</b> (0.0059002)	0.008523 (0.000314)	0.000541 (8.1e-5)	<b>0.008240</b> (0.005264)	0.010536 (0.000496)
900	0.000728 (5.1e-5)	<b>0.010165*</b> (0.004539)	0.008546 (0.000289)	0.000563 (5.5e-5)	<b>0.009867*</b> (0.005016)	0.010475 (0.000451)
1000	0.000578 (9.6e-5)	<b>0.003738</b> (0.002642)	0.008442 (0.000269)	0.000547 (4.5e-5)	<b>0.009902*</b> (0.004796)	0.010221 (0.000420)

## Estimation of Mean Reversion Illusion in the 1987 Case

- Segmentation of the Brady-Report:  
Early 1982 through 1986: Boom  
January 1987 through Crash: Exaggeration
- Can be confirmed by Generalized Likelihood Ratio Test.



## Simulation of the Model

- Sample: Jan 2, 1982 through Oct 16, 1987.
- Experiment: For 200 observations (Jan 1987 – Crash), simulate the old regime (1982 – 1986).

⇒ Distribution of  $S_{\text{no illusion}}(\text{Oct 16, 1987})$

Estimate of Crash Magnitude: Distribution of

$$\begin{aligned} & \log S_{\text{no illusion}}(\text{Oct 16, 1987}) \\ & - \log S_{\text{actual}}(\text{Oct 16, 1987}) \end{aligned}$$

$r_i$	$\mathbb{P}(r_i - 0.10 \leq r < r_i)$
-0.3	0.0029
-0.2	0.0753
-0.1	0.3652
0	0.4332
0.1	0.1160
0.2	0.0072
0.3	0.0001

## Conclusions

- Misperception of mean reversion expectations can cause stock-market crashes (Black 1988).
- In the case of 1987, the findings for a Vasicek-type mean reversion model support
  1. Black's hypothesis
  2. the segmentation of boom and exaggeration as stated in the Brady-Report.
- Simulations of the model show that a crash of more than -20 percent on a single day had a probability between 7 and 10 percent.  
A correction of more than -10 percent had 25 to 40 percent probability.