

Beyond “The Right Answers to The Wrong Questions”
Risk, Missed Opportunities and Financial Crises
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Last week we set out a very compressed history of Extreme Value Theory (EVT) from its genesis in 1928 to the present. In this week’s installment, we travel back in time to see what our risk technology, based on EVT and Expected Shortfall (ES), would have told a US equity investor in the run-up to the 1929 Crash.

That event, in common with other market crashes, was fueled by ‘irrational exuberance’ and a high degree of leverage. As legend has it, even the shoe-shine boys were buying shares on margin and Joseph P. Kennedy decided to exit the market when he started receiving stock tips from them. It is certainly the case that ‘smart money’ moved out of the market prior to October 1929. One would expect therefore to see some statistical evidence of increasing risk reflected in market prices.

This expectation is reinforced by examining the historic annualized return on the Dow Jones Index in the decade prior to the Crash. On three previous occasions when the annualized return had exceeded 40% there was a significant reversal. By September 1929 the annualized return on the Index hit 71%. Prominent Yale Economist Irving Fisher published an article explaining that a permanently high plateau in US equity prices had been achieved. What could possibly go wrong?

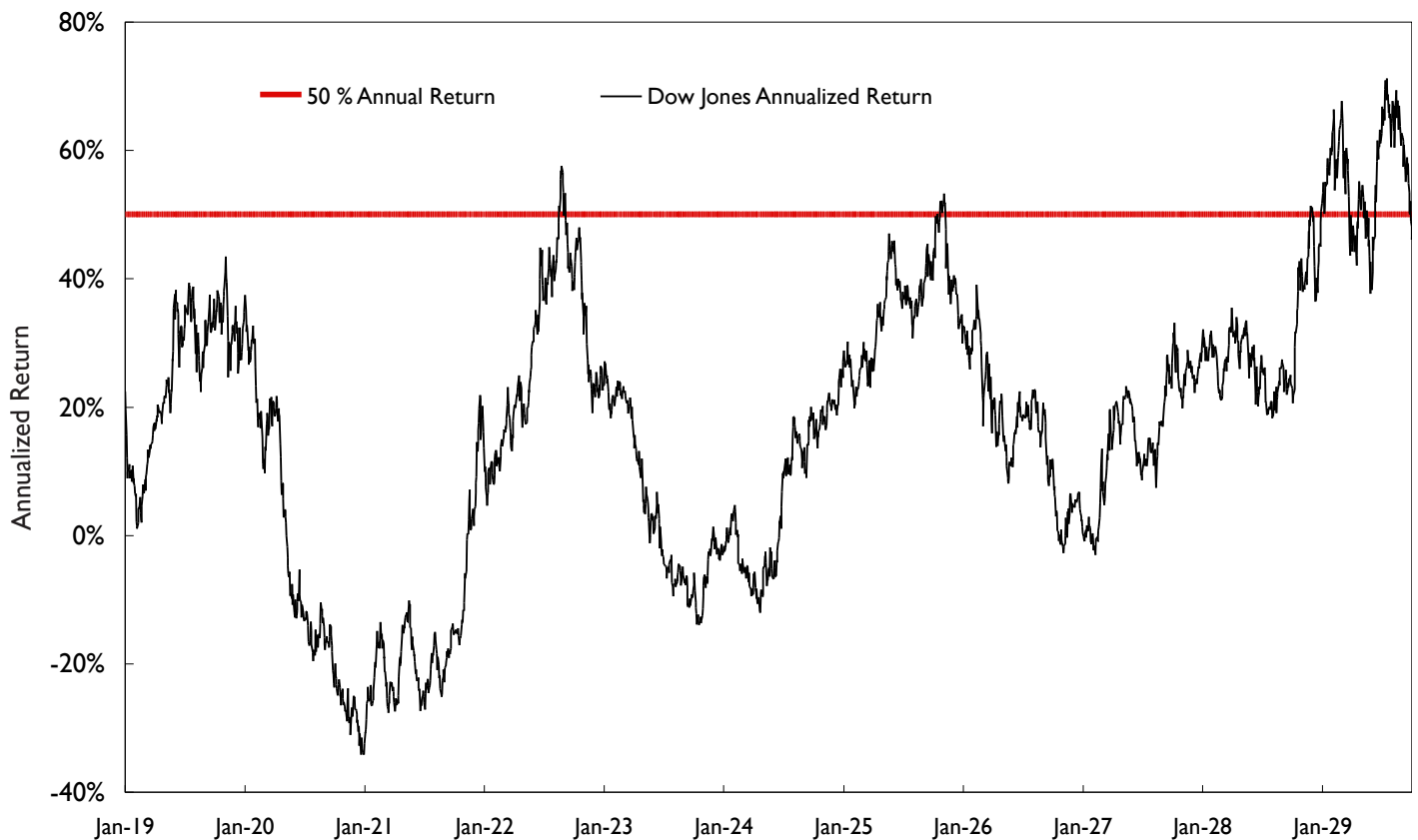


Figure 1. The history of 250-day annualized returns on the Dow Jones Index in the decade prior to the 1929 Crash.

Our revisionist history of the 1929 Crash will be carried out by means of Risk Reports produced at the end of each month using the daily close returns on the Dow Jones Index for the previous 250 trading days (approximately one year). The reports record the worst loss experienced in the data sample, the expected frequency of such losses according to our tail fit and the expected shortfall conditional on exceeding that loss. This is the information that

would have been available to an investor, armed with our EVT-based risk technology, on the first trading day of the following month.

While the worst loss in 1928 was only 3.75%, many investors were buying shares on margin of as little as 10%. So a 3.75% loss in the market might produce a real loss of 37.5%.

By the end of December 1928, our tail model said the frequency of such a loss was one day in 121—about once in six months (given approximately 250 trading days in a year). The corresponding expected shortfall was a loss of more than 6% – or 60% at the common leverage level. This might well have put a damper on some of the exuberance!

So too might the steadily increasing frequency at which even bigger losses were likely to occur according to the Risk Reports. By the end of February 1929 the frequency estimate had changed from one day in 121 to one day in 101 and in fact, on 25 March a new worst loss of 4.11% was realized. Note however that the likelihood of such a loss did not diminish. In fact, after the 22 May loss of 4.22% was recorded, the likelihood of a still further breach rose dramatically in August and September. At the beginning of October the expected shortfall was over 7%, threatening a leveraged investor with a loss of 70% from a single day's event. What is more, the expected frequency was one day every four months.

By contrast, should the investor have relied on a Normal model, he'd have been told that the frequency of losses of more than 4.22% was one day in 1461—only once in 5.8 years—and the expected shortfall was only 4.59%.

In the event, even the much more dire prediction of the 30 September 1929 EVT Risk Report underestimated the average of the new record losses which occurred in October. It would however have prepared anyone still in the market for the horror of what was to come.

Dow Jones Index	Report Date	Worst Return (prev. 250 days)	Probability of Loss	Expected Shortfall Estimate	Breach Date	Breach Return
1929	31-Dec-28	-3.75	1 day in 121	-6.11	-	-
	31-Jan-29	-3.75	114	-6.30	-	-
	28-Feb-29	-3.75	101	-6.35	25-Mar-29	-4.11
	31-Mar-29	-4.11	100	-7.01	-	-
	30-Apr-29	-4.11	107	-6.85	22-May-29	-4.22
	31-May-29	-4.22	90	-7.17	-	-
	30-Jun-29	-4.22	101	-7.22	-	-
	31-Jul-29	-4.22	106	-7.15	-	-
	31-Aug-29	-4.22	97	-7.24	-	-
	30-Sep-29	-4.22	83	-7.16	3-Oct-29	-4.22
					23-Oct-29	-6.33
					28-Oct-29	-13.47
					29-Oct-29	-11.73
				Oct. Average Breach	-8.94	

Table 1. Monthly EVT Risk Reports for the Dow Jones Index using data to the close of trading on the last day of trading up to and including the date of the report. Any subsequent breaches of the previous worst loss level in the following month are recorded and averaged when there was more than one breach in a month. (The 3 October 1929 return of -4.22% differed from the previous low only in the third decimal place.)

Of course, there was no reason to go through October 1929 without updating the risk estimates. Risk Reports could have been updated daily. Tables 2 and 3 show what daily reports in October 1929 would have revealed.

In the first three weeks of October, the estimated frequency of still worse losses moved from one day in 83 to one day in 67. At this point the expected shortfall was 7.25%.

An analyst using the Normal model would also have become more pessimistic, putting the frequency of such a breach at one day in 536 –less than one day in two years. His estimate of the expected shortfall would have been only 4.65%. On 23 October, the Dow Jones Index lost 6.33%.

Dow Jones Index	Report Date	Worst Return (prev. 250 days)	Probability of Loss	Expected Shortfall Estimate	Breach Date	Breach Return
1929	30-Sep-29	-4.22	1 day in 83	-7.16	-	-
	1-Oct-29	-4.22	83	-7.19	-	-
	2-Oct-29	-4.22	83	-7.20	3-Oct-29	-4.22
	3-Oct-29	-4.22	76	-7.27	-	-
	4-Oct-29	-4.22	76	-7.24	-	-
	7-Oct-29	-4.22	75	-7.23	-	-
	8-Oct-29	-4.22	75	-7.24	-	-
	9-Oct-29	-4.22	75	-7.24	-	-
	10-Oct-29	-4.22	75	-7.25	-	-
	11-Oct-29	-4.22	75	-7.28	-	-
	14-Oct-29	-4.22	75	-7.25	-	-
	15-Oct-29	-4.22	76	-7.20	-	-
	16-Oct-29	-4.22	73	-7.21	-	-
	17-Oct-29	-4.22	72	-7.23	-	-
	18-Oct-29	-4.22	71	-7.22	-	-

Table 2. Daily EVT Risk Reports for the Dow Jones Index from the end of September to two weeks prior to ‘Black Monday’ using data to the market close on the last day of trading up to and including the date of the report.

After this loss, our updated estimate of the frequency of a still worse loss was one day in 143 with an expected shortfall of almost 11%. The Normal model however saw such a loss as a freak event with a frequency of only one day in 58,000. In the extremely unlikely event that you were hit by lightning (again), the expected shortfall would only be 6.67%. On Black Monday, 28 October 1929, the Dow Jones Index lost 13.47%.

Dow Jones Index	Report Date	Worst Return (prev. 250 days)	Probability of Loss	Expected Shortfall Estimate	Breach Date	Breach Return
1929	21-Oct-29	-4.22	1 day in 67	-7.26	-	-
	22-Oct-29	-4.22	67	-7.25	23-Oct-29	-6.33
	23-Oct-29	-6.33	143	-10.79	-	-
	24-Oct-29	-6.33	143	-10.72	-	-
	25-Oct-29	-6.33	143	-10.75	28-Oct-29	-13.47
	28-Oct-29	-13.47	551	-23.35	-	-
	29-Oct-29	-13.47	420	-23.87	-	-
	30-Oct-29	-13.47	402	-24.20	-	-

Table 3. Daily EVT Risk Reports for the Dow Jones Index for the week prior to ‘Black Monday’.

The pessimism of the EVT Risk Reports continued after Black Monday. The crushing loss of 13.47% (or 134.7% for those who were highly leveraged) was a one day in 400 event at the end of October, according to our tail model. The predictions of the Normal model were, as you might now expect, hopelessly inadequate.

While the chances of being hit by lightning are likely higher than the Normal model’s prior assessment of the probability of a loss in excess of 6.33%, they pale into insignificance beside that model’s estimate of the likelihood of the Black Monday loss—one day in 100 million years!

In the final installment of this article, we will turn to more recent history and apply our EVT technology in the run-up to the current financial crisis.