

Likely Gains from Market Timing

The investment manager who hopes to outperform his competitors usually expects to do so either by the selection of securities within a given class or by the allocation of assets to specific classes of securities. Potentially, one of the most productive forms of the latter strategy is to hold common stocks during bull markets and cash equivalents during bear markets ("market timing").

In a perfectly efficient market, any attempt to obtain performance superior to that of the overall "market portfolio" (taking into account both risk and return) by picking and choosing among securities would fail. Although few investment managers are ready to admit that U.S. security markets are completely efficient, there is a growing awareness that inefficiencies are few: Any divergence between the price of a security and the "intrinsic value" that would be assigned to it by well informed and highly skilled analysts is likely to be small, temporary and difficult to identify in advance. Empirical studies of the performance of professionally managed portfolios yield results consistent with this view: Few, if any, provide better-than-average return relative to risk year in and year out.

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Some have argued that abnormal gains from selection of individual stocks or even industry groups are likely to be too small to justify the costs associated with attempts to identify and take advantage of apparent inefficiencies. Instead, it is said, the big gains are to be made by successful market timing. This approach is sufficiently popular to be recognized as one of several major "management styles." When portfolio values shrink in extended bear markets, investors increasingly regard this style as a likely cure for their ills. Thus managers committed to timing strategies with the skill or luck to have moved to cash equivalents in the bear market of 1973-1974 were able to attract money in the latter part of 1974, while their competitors suffered both decreases in the market value of assets and often actual loss of accounts. Market efficiency implies that it should be at least as difficult to predict market turns as to identify specific securities that will perform abnormally well or poorly. Moreover, attempts to take advantage of such predictions entail non-recoverable transaction costs, and expose investment funds to larger losses when errors are made. On the average, stocks outperform short-term money market instruments. Without superior predictive ability, one is likely to forego return by shifting from stocks to cash equivalents. But this is to state the obvious. How superior must one's predictions be to implement a market timing style effectively?

This article explores the potential gains from market timing and shows how they relate to the manager's ability to make correct predictions. Counter to widely held beliefs, the results suggest that the gains are likely to be modest at best, and

that only a manager with truly superior predictive ability should even attempt to time the market.

The Assumption of Annual Reviews

The aggressive investment manager would like to call every market turn. Whenever he foresees a change large enough to cover transaction costs, he can move all assets under management into stocks (in the case of a predicted rise in the market) or out of stocks and into, say, Treasury bills (in the case of a predicted fall in the market). An even more dramatic way to time the market is to implement bullish predictions by purchasing securities highly sensitive to market swings (i.e. with large beta values) or buying securities on margin, and to implement bearish predictions by selling such securities short.

The problem, of course, is that the top or bottom of a cycle is only obvious after the fact (and sometimes long after the fact). Moreover, different analysts will identify different points as "major" peaks and troughs of the market, even in retrospect.

To provide a rough assessment of the likely gains from virtually clairvoyant market timing, we begin this article by comparing two strategies. The first involves simply buying and holding the average; the second, buying at the low for a year, selling at the next annual high, buying at the next annual low, etc. It considers only capital gains and losses, under the simplifying assumption that dividends from fully invested positions and interest from cash-equivalent positions would be roughly equal and spent as received. For the three periods analyzed, each beginning at an annual low and ending at an annual high, the results (expressed in terms of equivalent constant annual rates of growth of capital) were as follows:

From	To	Equivalent Annual Rate of Capital Growth	
		Buy-and-hold Strategy	Timing Strategy
1929	1972	3.8%/year	19.9%/year
1934	1972	6.6	17.3
1946	1972	7.1	15.7

Of course no one could do this successfully over an extended period of time. To move from the realm of fantasy to that of at least potential reality, the remainder of the article considers only strategies involving scheduled annual reviews. The manager is assumed to assess the outlook for the market at the beginning of each year, then place the assets under management in either stocks of average risk or short-term money market instruments for the remainder of the year. The first alter-

native is represented by Standard and Poor's Composite Index, the second by prime bankers' acceptances (up to 1942) or U.S. Treasury bills (after 1942).¹

To reflect the cost of shifting funds, transaction costs equal to two per cent of the value of the assets under management are assessed every time there is a shift from stocks to cash equivalents or vice versa. Readers who prefer a different assumption will find it a relatively simple matter to adjust our results. While better performance might be obtained by reviewing a portfolio more than once each year, increased transactions costs would reduce potential gains.

"Good" versus "Bad" Market Years

Consistent with the strategy considered, each year can be categorized as either a good or a bad (stock) market year. In a good year, the total return, including dividends, on stocks exceeds that on cash equivalents. In a bad year the reverse holds. In terms of bad and good years, successful investment timing can be defined as holding stocks in good market years and cash equivalents in bad market years.²

Table 1 shows the annual total returns for cash equivalents (prime bankers' acceptances or Treasury bills) and stocks (Standard and Poor's Composite Index) from 1929 through 1972. The third column indicates whether the market was good or bad in the year in question.

Gains from Perfect Timing

Table 2 summarizes the results for three investment strategies over three different periods. Table 1 provides us with the data from which to construct a third strategy—buying and holding cash equivalents. Not surprisingly, this strategy, investing solely in cash equivalents, provided the lowest average return and the lowest variability of return. The second strategy involves investment solely in stocks (i.e., a buy-and-hold stock policy), which produced higher returns on the average, but at the cost of greater variability. The third strategy involves market timing, but with perfect predictive ability. In each year, funds were placed with the higher return investment medium for that year. For good market years, the return utilized in the calculations was the return on Standard and Poor's Composite Index. For bad market years, the return on cash equivalents was used. In each year for which a switch was made, transaction costs were deducted from the return.³

Three measures of performance are shown in

1. Footnotes appear at end of article.

TABLE 1. Annual Total Returns: Cash Equivalents and Stocks, 1929 to 1972

Year	Return on Cash Equivalents	Return on Stocks	Type of Year	Year	Return on Cash Equivalents	Return on Stocks	Type of Year
1929	5.03%	-7.93%	Bad	1951	1.76%	23.37%	Good
1930	2.48	-23.92	Bad	1952	1.84	17.71	Good
1931	1.57	-41.72	Bad	1953	2.11	-1.17	Bad
1932	1.28	-8.99	Bad	1954	0.93	51.23	Good
1933	0.63	52.98	Good	1955	1.93	30.96	Good
1934	0.25	-1.49	Bad	1956	2.91	6.44	Good
1935	0.13	46.32	Good	1957	3.66	-10.48	Bad
1936	0.16	33.28	Good	1958	2.13	42.44	Good
1937	0.43	-33.93	Bad	1959	4.29	11.79	Good
1938	0.44	30.05	Good	1960	3.53	0.28	Bad
1939	0.44	-0.76	Bad	1961	2.89	26.60	Good
1940	0.44	-9.93	Bad	1962	3.10	-8.83	Bad
1941	0.44	-11.15	Bad	1963	3.41	22.50	Good
1942	0.44	19.22	Good	1964	3.89	16.30	Good
1943	0.76	25.69	Good	1965	4.23	12.27	Good
1944	0.80	19.28	Good	1966	5.34	-9.99	Bad
1945	0.82	35.69	Good	1967	4.94	23.73	Good
1946	0.83	-7.78	Bad	1968	5.78	10.84	Good
1947	0.89	5.49	Good	1969	7.28	-8.32	Bad
1948	1.15	5.42	Good	1970	6.94	3.51	Bad
1949	1.15	17.76	Good	1971	4.98	14.12	Good
1950	1.28	30.55	Good	1972	5.01	18.72	Good

Table 2. The first is simply the arithmetic average of the annual rates of return. The second, the standard deviation of return, measures the extent of the deviations of return around this average. The third is the geometric mean of the annual

TABLE 2. Overall Performance: Cash Equivalents, Stocks, and a Policy with Perfect Timing

1929 to 1972			
	Cash Equivalents	Stocks	Perfect Timing
Average Return	2.38%	10.64%	14.86%
Standard Deviation of Annual Returns	1.96	21.06	14.58
Geometric Mean Return	2.36	8.49	13.99
1934 to 1972			
	Cash Equivalents	Stocks	Perfect Timing
Average Return	2.40%	12.76%	15.25%
Standard Deviation of Annual Returns	2.00	18.17	13.75
Geometric Mean Return	2.38	11.23	14.46
1946 to 1972			
	Cash Equivalents	Stocks	Perfect Timing
Average Return	3.27%	12.79%	14.63%
Standard Deviation of Annual Returns	1.83	15.64	12.46
Geometric Mean Return	3.25	11.73	13.99

returns, i.e. the constant rate of return that would have produced the same value at the end of the period as the actual returns, assuming no withdrawals during the entire period.

Obviously, perfect prediction of the four bad years from 1929 through 1932 and the extremely good year in 1933 would have paid handsomely. From 1929 through 1932, investment in stocks resulted in a loss of 62.85 per cent of the initial value, while investment in cash equivalents resulted in a gain of 10.72 per cent. On the other hand, stocks returned almost 53 per cent in 1933, while cash equivalents paid less than one per cent. These five years account for much of the superiority of the perfect prediction strategy relative to stocks over the period 1929 to 1972. As Table 2 shows, the differences between the buy-and-hold strategy and the perfect prediction strategy are considerably smaller from 1934 to 1972 and in the postwar period.

A policy involving accurate market timing has two advantages: It brings returns that are both higher on average and subject to less variability. As shown in Table 2, perfect timing gave an average annual return of 14.86 per cent per year from 1929 through 1972, while buying and holding stocks returned only 10.64 per cent—a difference of 4.22 per cent per year. The former policy brought less variable returns as well: The standard deviation of annual returns was 14.58 per cent per year, instead of 21.06 per cent.

To express the superiority of the perfect prediction strategy in a single number is, of course, a difficult task. Two measures will be provided here, and used in the subsequent analysis of less-than-

perfect predictions. The first is the geometric mean return, which is generally smaller than the arithmetic average, with the disparity larger, the greater the variability of the annual returns. As shown in Table 2, for the 1929 to 1972 period, the geometric mean returns for the two strategies differ by 5.50 per cent per year (13.99 - 8.49).

The second measure compares arithmetic average returns, but with variability held roughly constant.⁴ The results from the market timing strategy are compared with those of a policy in which a mixture of stocks and cash equivalents is held, with the particular mixture chosen to have the same standard deviation of annual returns as the timing strategy. Over the 1929 to 1972 period, such a strategy provided an average annual return of 8.10 per cent, or 6.76 per cent less than that provided by perfect timing.

The advantages of perfect timing are summarized in Table 3, using these two measures, for each of the three periods.

Barring truly devastating market declines similar to those of The Depression, it seems likely that gains of little more than four per cent per year from timing should be expected from a manager whose forecasts are truly prophetic. More human managers should expect even less satisfying results, with the actual gains depending, of course, on actual predictive abilities.

TABLE 3

Measure of Return	Alternative Used for Comparison	Period		
		1929-72	1934-72	1946-72
Geometric Mean Return	Buying and holding stocks	5.50	3.23	2.26
Annual Average Return	A mixture of stocks and cash equivalents with equal standard deviation of annual returns	6.76	5.01	3.78

Gains from Less-Than-Perfect Timing

To assess the likely performance of funds whose managers attempt to time the market and sometimes fail, we will use an extremely simple characterization of an admittedly complex process. Hopefully, it captures enough of the essence of the situation to provide useful insights. A different characterization giving similar results is described in the appendix.

At the beginning of each year the manager is assumed to predict either a good or a bad market year, then either leave his funds alone or move them to the alternative investment medium, depending on his prediction. As in the previous analysis, funds are assumed to be invested either in stocks or cash equivalents, with transaction costs of two per cent incurred whenever a change is made.

FIGURE 1. The Assumed Predictive Process

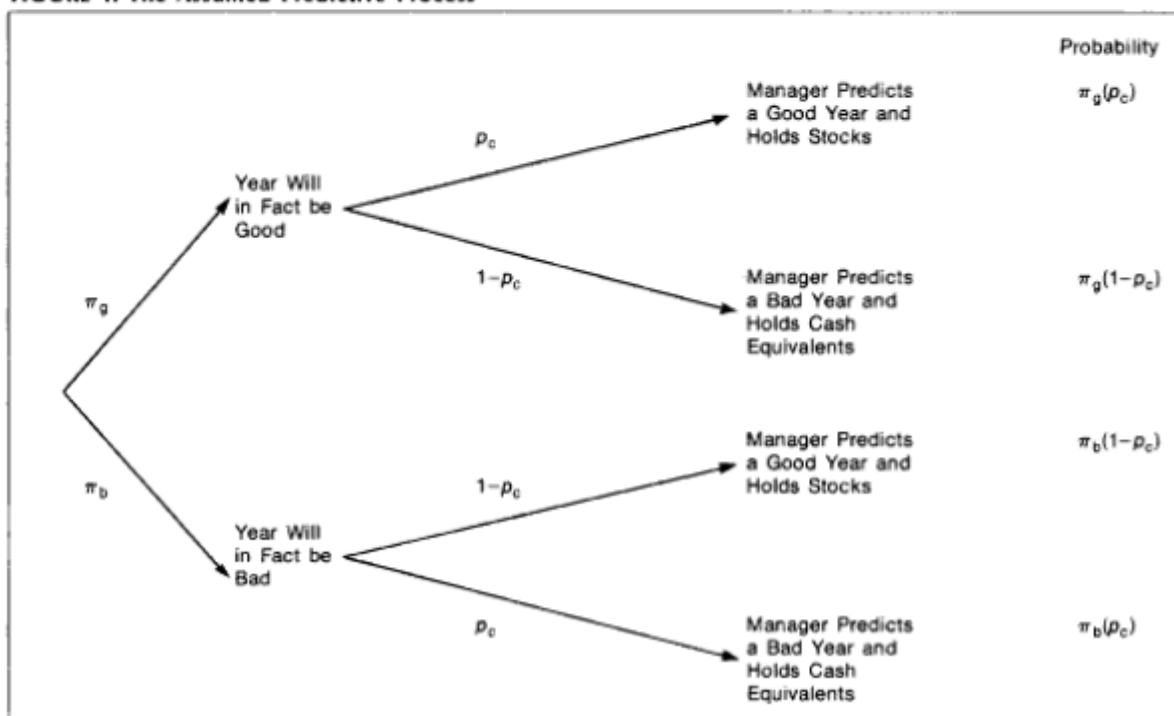


Figure 1 shows the essential difference between this and the previous analysis. The manager is assumed to be right only some of the time. Specifically, the proportion of correct predictions is represented by ρ_c . Thus the probability that he will predict a good year when in fact a good year is coming is ρ_c , while the probability is $(1-\rho_c)$ that he will predict a bad year when a good year is actually in store. His predictive ability when a bad year is in prospect is assumed to be of comparable accuracy, as shown. The actual probabilities of good and bad years are π_g and π_b , respectively, giving the overall probabilities for each of the four situations shown on the right of Figure 1.

We have already analyzed the special case in which $\rho_c=1$ (perfect prediction), using actual data. We now turn to an examination of the likely results obtained when ρ_c is less than 1.

To do this, assumptions must be made about the likelihood of good and bad years and the results associated with each possible combination. Table 4 presents historical values of the required variables. The proportion of good market years varied between 0.60 and 0.70. Returns on cash equivalents averaged slightly higher and varied slightly more in bad market years than in good, but these differences are relatively unimportant. Far more significant are the major differences between the returns on stocks in good and bad market years. Good

years have been somewhat less good (smaller average returns on stocks, with roughly the same standard deviation) and bad market years have been somewhat less bad (smaller average losses on stocks, and smaller standard deviations) in recent periods. The overall expected return for any given degree of predictive accuracy is simply a weighted average of the expected values for the four outcomes, with the probabilities of the outcomes used as weights:

$$\mu \text{ (the overall expected return)} = \sum_i \rho_i \mu_i$$

where

ρ_i = the probability of outcome i , and

μ_i = the expected return for outcome i .

Future values of these variables may differ substantially from those obtained in any one of these three historic periods. As shown in Table 3, the 1929 to 1972 period was the most favorable for a timing strategy, and the 1946 to 1972 period the least favorable.

Those observers who feel that recent events portend a future like the early years of The Great Depression are probably excessively pessimistic. On the other hand, the two decades following World War II may have been exceptionally favorable for holders of stocks. To get a balanced view of how a timing strategy might perform in the future, we have chosen the middle road, utilizing the values from the period 1934 to 1972. Readers who consider this choice unsatisfactory can easily substitute other values in our formulas.

Table 5 shows results based on the period 1934 to 1972. Each row corresponds to a different degree of predictive accuracy. The first shows the likely results for a manager who is right only half the time ($\rho_c=0.50$), and the last the likely outcomes for one who is right all the time ($\rho_c=1$).

The standard deviation of the overall return is slightly more difficult to calculate. The general formula is:⁵

$$\sigma^2 = \sum_i \rho_i \sigma_i^2 + \sum_i \rho_i (\mu_i - \mu)^2$$

where, in addition to symbols previously defined:

σ = the overall standard deviation, and

σ_i = the standard deviation of return for outcome i .

The resulting values are shown in column 3 of Table 5.

Thus far transaction costs have not been taken into account in the calculations. Although the overall standard deviation will also be affected, their major effect is to lower the overall expected return. For simplicity the latter effect will be ignored. However, the former can easily be handled. The respective probabilities that funds will be in

TABLE 4. Performance During Good and Bad Years

Measure	1929-72	Period 1934-72	1946-72
Proportion of Good Years	0.61	0.67	0.70
Return on Cash Equivalents in Good Years			
Mean	2.21%	2.27%	2.92%
Standard Deviation	1.72	1.72	1.57
Return on Cash Equivalents in Bad Years			
Mean	2.66%	2.68%	4.10%
Standard Deviation	2.26	2.45	2.12
Return on Stocks in Good Years			
Mean	24.10%	22.99%	20.43%
Standard Deviation	12.98	11.90	11.83
Return on Stocks in Bad Years			
Mean	-10.74%	- 7.70%	- 5.35%
Standard Deviation	11.64	8.94	5.03

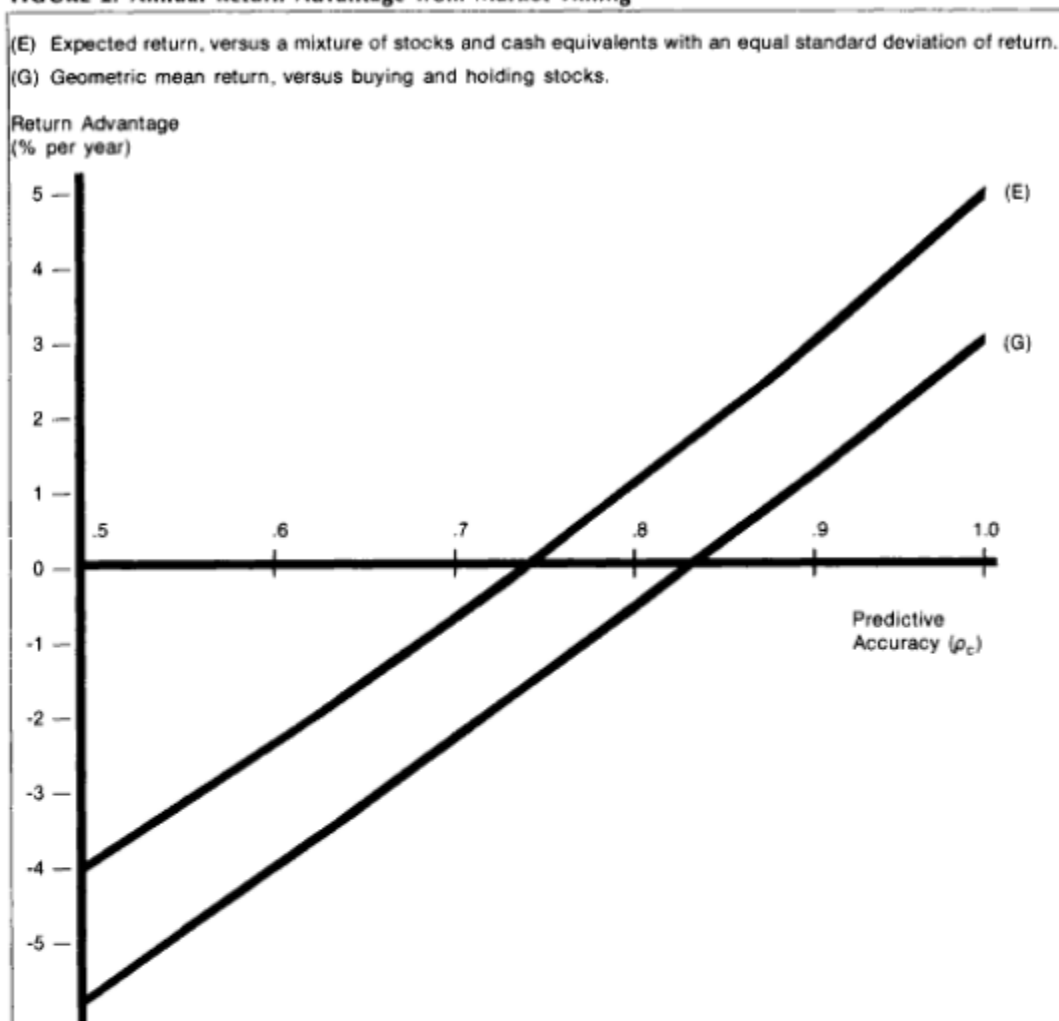
TABLE 5. Likely Results with Less-Than-Perfect Predictions

(1)	(2)	(3)	(4)	(5)	(6)	(7)
p_c	Expected Return	Standard Deviation of Return	Net Expected Return	Geometric Mean Return	Advantage: Geometric Mean Return vs Buying & Holding Stocks	Advantage: Expected Return vs a Mixture of Stocks and Cash Equivalents of Equal Standard Deviation of Return
0.50	7.63%	13.93%	6.63%	5.72%	-5.68%	-3.79%
0.51	7.81	13.98	6.81	5.89	-5.51	-3.65
0.52	7.98	14.03	6.98	6.06	-5.34	-3.51
0.53	8.15	14.07	7.15	6.23	-5.17	-3.46
0.54	8.33	14.11	7.33	6.40	-5.00	-3.21
0.55	8.50	14.15	7.50	6.57	-4.83	-3.06
0.56	8.67	14.19	7.67	6.74	-4.66	-2.91
0.57	8.85	14.22	7.85	6.91	-4.49	-2.75
0.58	9.02	14.25	8.02	7.08	-4.32	-2.59
0.59	9.19	14.28	8.20	7.25	-4.15	-2.44
0.60	9.36	14.31	8.37	7.42	-3.98	-2.28
0.61	9.54	14.34	8.54	7.60	-3.81	-2.12
0.62	9.71	14.36	8.72	7.77	-3.63	-1.96
0.63	9.88	14.39	8.89	7.94	-3.46	-1.80
0.64	10.06	14.40	9.07	8.11	-3.29	-1.63
0.65	10.23	14.42	9.24	8.29	-3.11	-1.47
0.66	10.40	14.44	9.41	8.46	-2.94	-1.31
0.67	10.58	14.45	9.59	8.64	-2.77	-1.14
0.68	10.75	14.46	9.76	8.81	-2.59	-0.97
0.69	10.92	14.47	9.94	8.99	-2.42	-0.80
0.70	11.10	14.48	10.11	9.16	-2.24	-0.63
0.71	11.27	14.48	10.29	9.34	-2.06	-0.46
0.72	11.44	14.49	10.46	9.51	-1.89	-0.29
0.73	11.61	14.49	10.64	9.69	-1.71	-0.11
0.74	11.79	14.49	10.81	9.87	-1.54	0.06
0.75	11.96	14.48	10.99	10.04	-1.36	0.24
0.76	12.13	14.48	11.17	10.22	-1.18	0.42
0.77	12.31	14.47	11.34	10.40	-1.00	0.60
0.78	12.48	14.46	11.52	10.58	-0.82	0.78
0.79	12.65	14.45	11.69	10.76	-0.65	0.96
0.80	12.83	14.44	11.87	10.94	-0.47	1.14
0.81	13.00	14.42	12.04	11.12	-0.29	1.33
0.82	13.17	14.40	12.22	11.30	-0.11	1.52
0.83	13.35	14.38	12.40	11.48	0.07	1.71
0.84	13.52	14.36	12.57	11.66	0.25	1.89
0.85	13.69	14.34	12.75	11.84	0.43	2.08
0.86	13.86	14.31	12.92	12.02	0.61	2.28
0.87	14.04	14.28	13.10	12.20	0.80	2.47
0.88	14.21	14.25	13.28	12.38	0.98	2.66
0.89	14.38	14.22	13.45	12.56	1.16	2.86
0.90	14.56	14.19	13.63	12.75	1.34	3.05
0.91	14.73	14.15	13.81	12.93	1.53	3.25
0.92	14.90	14.11	13.98	13.11	1.71	3.45
0.93	15.08	14.07	14.16	13.29	1.89	3.65
0.94	15.25	14.02	14.34	13.48	2.08	3.86
0.95	15.42	13.98	14.52	13.66	2.26	4.06
0.96	15.60	13.93	14.69	13.85	2.44	4.26
0.97	15.77	13.88	14.87	14.03	2.63	4.47
0.98	15.94	13.83	15.05	14.22	2.81	4.68
0.99	16.11	13.77	15.23	14.40	3.00	4.89
1.00	16.29	13.71	15.40	14.59	3.19	5.10

cash equivalents or stocks in each of two consecutive years can be computed. The probability of a switch in any given year will equal (1) the probability that stocks will be held in year t and cash

equivalents in year $t+1$, plus (2) the probability that cash equivalents will be held in year t and stocks in year $t+1$. Assuming that outcomes in successive years are uncorrelated, this probability can

FIGURE 2. Annual Return Advantage from Market Timing



be determined directly. Expected transaction costs can then be computed by simply multiplying the assumed cost by the probability that it will be incurred in any given year. Column 4 of Table 5 shows the overall expected return after this amount has been subtracted. The result, the net expected return, is the predicted value of the average annual return. The correspondence can be seen by comparing the value in the final row of Table 5 (15.40) with the actual result for the 1934 to 1972 period (15.25) shown in Table 2.

The fifth column in Table 5 shows the estimated long-run return for each level of predictive ability. This is the predicted value of the geometric mean return after many years have passed.⁶ Again, the correspondence can be seen by comparing the value in the final row of Table 5 (14.59) with the actual result for the 1934 to 1972 period (14.46)

shown in Table 2.

Comparable values for a policy of buying and holding stocks can be estimated using the same formulas, with the probabilities adjusted appropriately. For the values assumed in Table 5, the resulting geometric mean return is 11.40 per cent per year. The sixth column in the table shows the difference between the geometric mean return for the market timing strategy and that likely to be obtained by simply buying and holding stocks.

The final column in Table 5 shows the difference between the expected net return for the market timing strategy and the expected return from a mixture of stocks and cash equivalents with a comparable standard deviation of return.

The values in columns 6 and 7 of Table 5 are plotted in Figure 2. They suggest that a manager who attempts to time the market must be right

roughly three times out of four, merely to match the overall performance of those competitors who don't. If he is right less often, his relative performance will be inferior. There are two reasons for this. First, such a manager will often have his funds in cash equivalents in good market years, sacrificing the higher returns stocks provide in such years. Second, he will incur transaction costs in making switches, many of which will prove to be unprofitable.

Conclusion

The conclusion is fairly clear. Attempts to time the market are not likely to produce incremental returns of more than four per cent per year over the long run. Moreover, unless a manager can predict whether the market will be good or bad each year with considerable accuracy (e.g., be right at least seven times out of ten), he should probably avoid attempts to time the market altogether.

This pessimistic view will not appeal to those who feel that they can avoid the next bear market by judicious shifts of funds out of stocks and into short-term low-risk instruments. Some are now doing this, and others are actively considering it. Overall, of course, funds cannot be "shifted" beyond any changes in the market values of the relevant securities outstanding. But individual in-

vestors can and do make such shifts.

It is said that the military is usually well prepared to fight the previous war. A number of investors now engaging in active market timing appear to be preparing for the previous market. Unfortunately for the military, the next war may differ from the last one. And unfortunately for investors, the next market may also differ from the last one. ■

APPENDIX

A manager who keeps assets in stocks at all times is like an optimistic market timer. His actions are consistent with a policy of predicting a good year every year. While such a manager may know that such predictions will be wrong roughly one year out of three, such an attitude is nonetheless likely to lead to results superior to those achieved by most active market timers.

On the other hand, managers whose actions can be characterized by the model described in this article may be regarded as pessimistic. This is most obvious when $p_c = 0.50$. A manager of this type with no predictive ability at all will make a gloomy prediction as often as a rosy one. He will not only make mistakes, but will also predict bad years too often.

Table A1 shows this, under the assumption that good years occur two-thirds of the time. As the table illustrates, a less-than-perfect predictor is likely to foresee only some of the good years: His probability of pre-

FIGURE A1. Unbiased Predictions

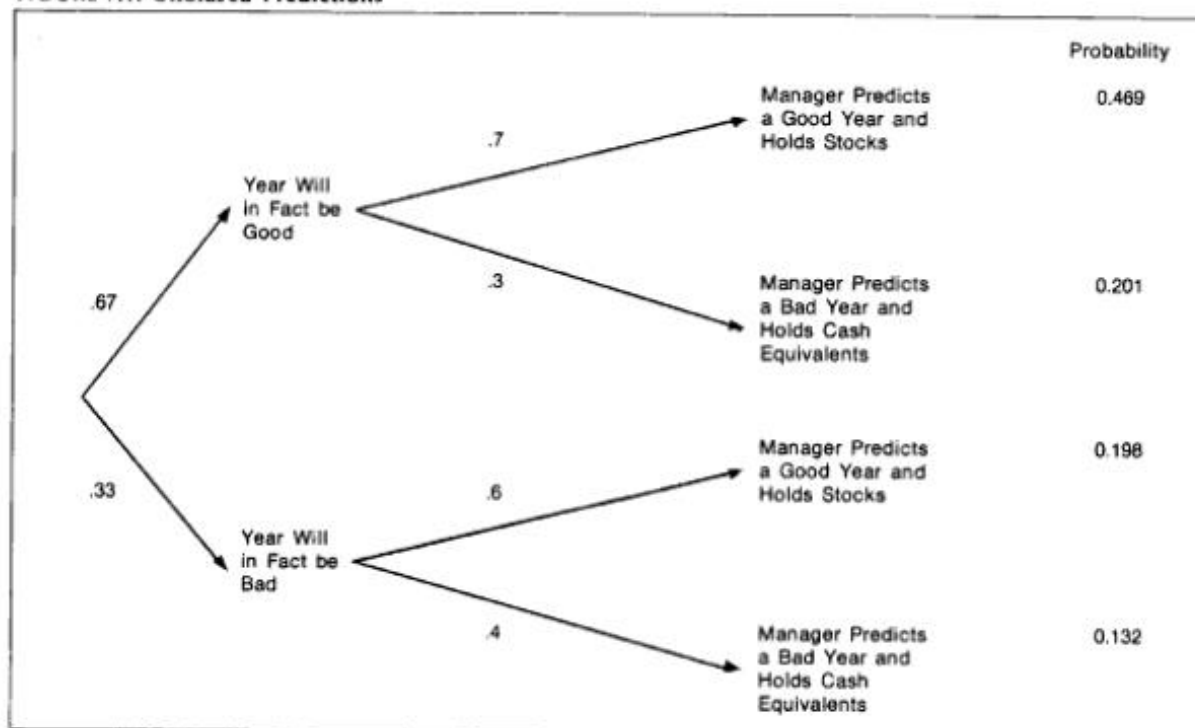


Table A1. Probability that a Manager Will Predict a Good Year, When the Actual Probability Is 0.67

Predictive Accuracy	Probability Manager Will Predict A Good Year
0.50	0.50
0.60	0.53
0.70	0.57
0.80	0.60
0.90	0.63
1.00	0.67

dicting a good year is less than the probability of its occurrence.

This suggests that a slightly different characterization of a market timer may be worth considering. Thus far we have assumed that the probability of predicting a good year prior to a good year equals the probability of pre-

dicting a bad year prior to a bad year. Since good years are more likely than bad ones, this makes such a predictor biased in the manner shown in Table A1.

To reduce or eliminate this bias, the predictor must be more accurate in good years than in bad years. This follows from the greater frequency of good years and is, of course, quite plausible. One who buys and holds stocks can be considered perfectly accurate in good years and perfectly inaccurate in bad years. A market timer with some predictive ability might provide greater than zero accuracy in bad years and less than perfect accuracy in good years, but the former might still fall below the latter.

The model in the text provides one extreme assumption: equal accuracy in both good and bad years. This appendix considers another: We assume that the manager's predictions are unbiased in the sense that the probability that he will predict a good year equals the probability that there will in fact be a good year.

FIGURE A2. Annual Return Advantage from Market Timing with Unbiased Predictions

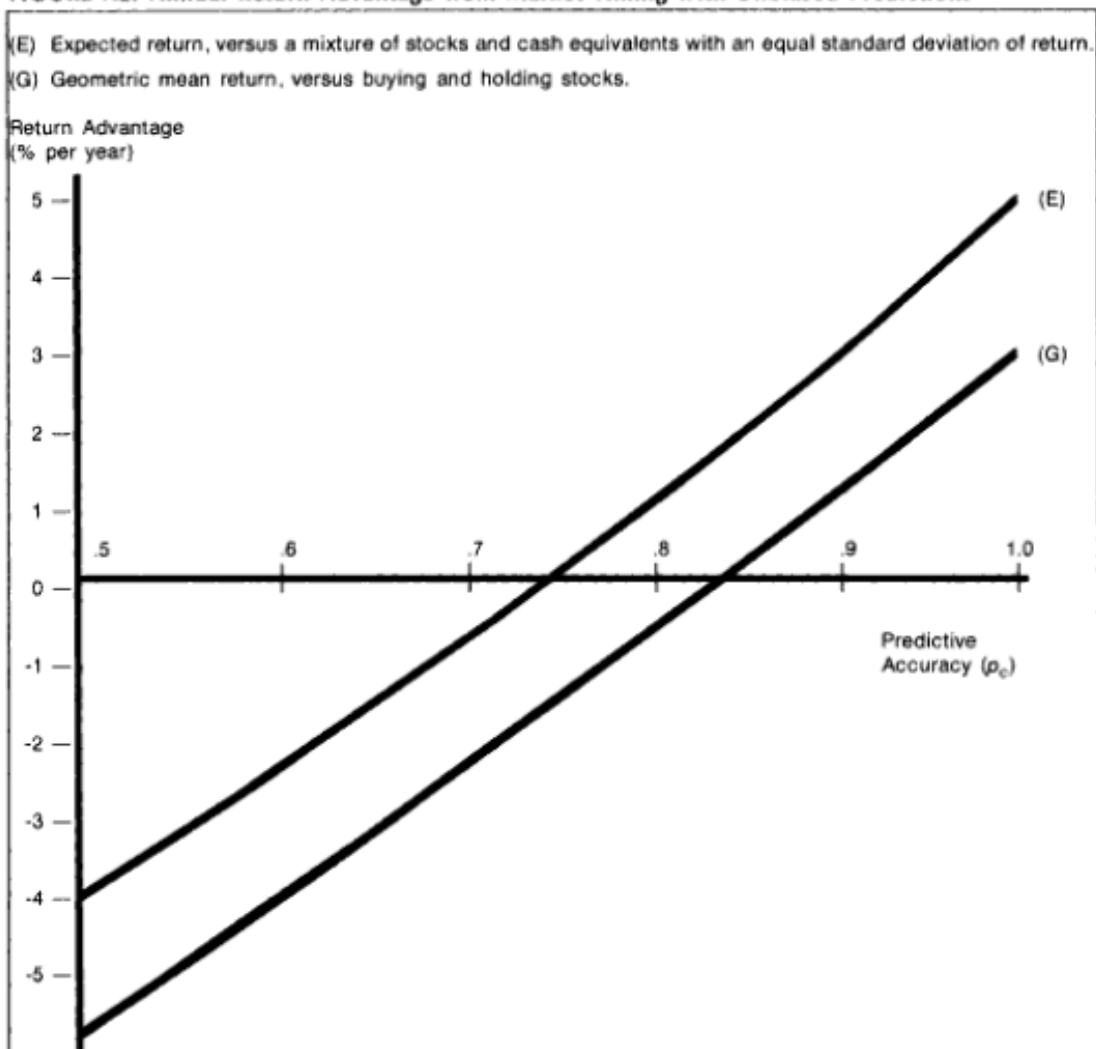


Figure A1 provides an example. The probability that such a manager will predict a good year is $0.469 + 0.198$, or approximately 0.67, the probability that a good year will in fact occur. The probability that the prediction will be correct is $0.469 + 0.132$, or approximately 0.60. The latter figure measures his overall predictive accuracy.

Figure A2 shows the advantage gained by such a manager for various levels of predictive accuracy, using the measures employed in Figure 2. Interestingly, the results do not differ significantly from those obtained earlier.

It should be noted that a manager with no predictive ability at all could provide a better than 50-50 predictive accuracy following an unbiased approach. Imagine a person throwing a die every year, then predicting a good year if numbers 1 through 4 turn up, and a bad year if numbers 5 or 6 turn up. Figure A3 portrays the resulting probabilities, assuming that the probability of a good year, like the probability of predicting one, is 0.67. The predictive accuracy of such a scheme is $0.449 + 0.109$, or 0.558. But, as Figure A2 shows, the outcome is still substantially inferior to buy-and-hold strategies. ■

Footnotes

1. Dividends have been added to the relative change in the Standard and Poor's Composite Index to obtain the total annual returns. This is equivalent to assuming all dividends held in cash until the end of

the year in which they are paid.

2. Consideration of transaction costs would alter this conclusion slightly, but this added factor will be ignored here. Transaction costs have, however, been taken into account in all calculations.
3. In each case, funds were assumed to be in the "right" investment at the beginning of the initial year of the period being analyzed.
4. This equalizes one measure of performance (variability) to allow concentration on the other (arithmetic average return). To accomplish this, a constant proportion of stocks relative to total assets (at market value) was used at the beginning of each year, with the proportion selected to give the same overall variability as that obtained from the relevant timing strategy.
5. This is a general relationship and requires no assumptions about normality, independence, etc.
6. The geometric mean return is estimated using the approximation:

$$100 \left[\frac{\mu}{100} + \frac{\left(\frac{\sigma}{100} \right)^2}{2 \left(1 + \frac{\mu}{100} \right)} \right]$$

where:

- μ = the overall net expected return (column 4)
 σ = the overall standard deviation of return (column 5).

FIGURE A3. An Unbiased Predictor with no Predictive Ability

