A Slightly Predictable Stock Market

Is There Enough Reliable Information to Avoid Market Downturns?

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February 1, 2013

Summary

Over the past three years the author funded a research project to determine whether a diligent investor could avoid stock market downturns.Experience at the blackjack table suggestedthat a small amount of informationcould lead to superior returns. But the blackjack problem had since become well known and is almost trivial compared to the vast casino called the stock market.There were two research principles for "Avoiding 2008," as the project was known within the author's company. First, rely on research by academics and market professionals as much as possible. Second, use statistical research and simulation techniques designed to minimize the problem of hindsight bias.The author concluded that information can indeed be combined in an optimal way to achieve risk adjusted returns superior to those of a buy-and-hold investor.

Blair Hull founded *Hull Trading Company* in 1985 and served as the firm's chairman and chief executive officer before selling it to Goldman Sachs in 1999. Hull went on to found *Matlock Capital*, and is now founder and managing partner of *Ketchum Trading, LLC*, a proprietary trading firm that trades and provides liquidity in futures, options, cash equities and exchange traded funds. He also manages his family office, *Hull Investments, LLC*.

My experience at the Blackjack table provides an example of successful investing in a slightly predictable market, where a talented player can expect at most a three percent advantage (51.5% win probability versus a 48.5% probability of loss). A more typical two percent advantage can still lead to profitable playingthrough proper discipline and analysis. We apply this mindset to the problem of optimal medium-term investment in the US equity market, which has been shown by academics to be modestly predictable using widely observed technical and macroeconomic variables. Any practical implementation must avoid heavy losses from market declines such as the severe downturn of 2008-2009. This is a second goal of the research.

We present results of a simulation from June 2001 through January 2013 that uses regression based forecasts to take daily positions in E-mini S&P 500 futures contracts proportional to expected returns. The simulation produced returns of 19.0%annually with aSharpe ratio of 1.08. This compares favorably to a buy-and-hold strategy over the same period, which produced returns of 3.1% annually and aSharpe ratio of0.24.

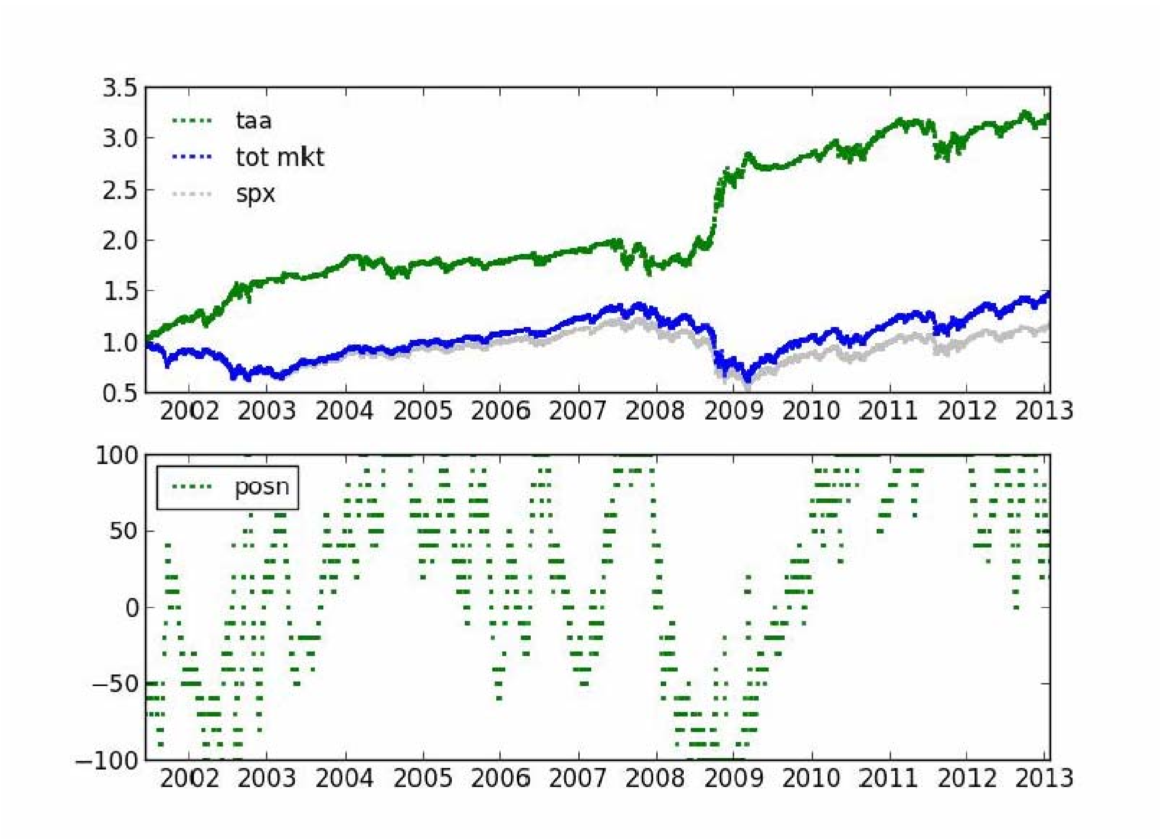
Table 1: Walk Forward Simulation Results

Daily, monthly and weekly data were collected from 1990 to present.Regressions were run every two weeks beginning in June 2001. (Explanatory variables came from academic work described at the end of this paper.)Expected returns were calculated based on the regression estimates, and positionswere taken daily in S&P 500 E-mini futures contracts. Position sizes were proportional to the expected returnswith a cap of 100 contracts long or short. Every two weeks, the oldest two weeks of data were removed and newdata were added, which kept the look back window at approximately ten years.

Year	**Profit / (Loss)**	**Average Exposure**	**Return in Percent**
2001	908,350	2,800,617	32.4
2002	987,930	2,734,872	36.1
2003	222,445	1,435,831	15.5
2004	471,280	4,182,980	11.3
2005	45,780	3,221,491	1.4
2006	274,220	2,587,387	10.6
2007	(107,350)	4,777,553	-2.3
2008	2,837,470	4,149,082	68.4
2009	559,180	1,630,141	34.3
2010	1,162,845	4,623,284	25.2
2011	176,770	6,086,084	2.9
2012	939,130	4,716,790	19.9
2013	190,205	2,770,741	6.9
Averages	666,789	3,516,681	19.0

Chart 1:Buy and Hold versus Simulated Results

The graph below shows the simulated returns, the total return on the S&P 500, and the return on the S&P 500 excluding dividends. The simulated returns resulted in wealth 3.25 times the initial investment versus 1.50 for the stock market with dividends. The second graph shows the positions in S&P 500 E-mini futures contracts. Notice that the only two maximum negative signals occurred in 2001-2 and in 2008. The rest of the time we were primarily long the market.



Potential Explanatory Variables Considered

In order to include a variable in our database we must believe there is a causal relationship between the variable and the S&P 500 return. In addition, we are more likely to include the variable if it is mentioned in the academic literature. We do include twoproprietary variables that are not mentioned in the literature.We are currently monitoring 18 potential variables.

Restricting Variables to Correct Signs

Campbell and Thompson (2010) suggested that when using monthly data from 1920, restricting coefficients to the sign of the hypothesis improves out of sample results. We find little difference in restricting signs out of sample but we observe that the majority of the time the signs are consistent with our hypothesis.

Variable Selection Criteria

Although we have 18 potential variables in the database, the model only chooses a subset of those variables every two weeks. The selection and weights of those variables uses a proprietary algorithm that combines regression, quadratic programing and machine learning.

Marginal Contribution of Variables

We keep track of the mean of each variable, the coefficient and the contribution of each variable. We find it instructive seeing which variables are bullish or bearish.The sum of the contributions plus the mean of the past return equals the predicted return in the next six months.

Transaction Costs

The 12 years of the simulation showed 9,240 outright futures contracts trades and 2,830 spread trades. We assumed that the market was one tick wide and we crossed the spread each time we traded. As a result, the simulated account was charged half of an S&P 500 E-mini futures contract tick ($12.50/2 or $6.25) plus exchange and clearing fees assumed to be $0.75, for a total of $7.00.For spreads the market width was one fifth the size, $2.50 plus $1.50, or $4.00 per spread. Total transaction costs totaled (9,240 x $7.00) plus(2,830 x $4.00), or $76,000. Average investors would have paid slightly more.

Taxes

One of the advantages of minimal transactions is that no taxes are paid until a position is closed out. So if we can modify our equity position at an advantage should we trade our existing portfolio or trade futures? For now we assume that trading futures and getting 60/40 tax treatment is our best way of implementing this strategy. Notice that the difference between buy and hold and the simulation is over stated by the taxes that would be paid by closing positions in trading futures. For individuals with 401k's or IRA's there will be no tax implications. Because of taxes this vehicle may be best for 401K, IRA and foundation accounts.

Maximum Information Ratio

Rick Anderson[1], a member of our research group, has pointed out that if we use a longer forecasting horizon then we cap our information ratio. Using the fundamental law of active management from *Active Portfolio Management*by Grinold and Kahn (1999), he asked the following question: What if you knew with certainty the return on stocks in the next six months and used that information to make daily bets? The correlation between tomorrow's return and the return in six months is 0.10. Then from Formula 6.1 on page 147 of Grinold and Kahn the maximum information ratio becomes 0.10 times the square root of 252, or 1.59. Rick Anderson also considered annual bets on the stock market with perfect information going back to 1926. The information ratio on that strategy would have been 1.5. This maximum gives us some sense of the limit for performance we can expect from the system we are attempting to build.

Bet Size

How should we use this information in managing an equity portfolio? Given the uncertainty of informationand taxes, what strategy will lead to the most wealth over the long run?Our colleague Rick Anderson suggests that this strategy is similar to a hedge fund, and one should allocate just as one would any other alternative investment and leave the remaining equity portfolio alone. Since the maximum information ratio on this investment cannot exceed 1.50 asdiscussed above, this would imply a maximum exposure that would be consistent with our other hedge fund investments. On the other hand, one could say that the average investor already is in a risky asset class: equities, and that one should be more aggressive and hedge the entire portfolio if our signal is extremely negative. A third alternative would be to look at the probability of being on the right side of the market. Richard Epstein in “The Theory of Statistical Logic and Gambling” (1969)shows that if one has an urn with balls that vary in winprobability,then the optimal growth of capital is achieved by wagering a percentage of one’s capital equal to win probability minus lose probability. If we could determine our win probability accurately, we could determine what to wager. (See graph of predicted versus actual below.) Assume our probability of winning is 60% then we would wager 20% (60-40) of our capital.Given that we are more concerned about losses, we might wager more onextremely negative indications.The issue of how large a position to take and how to take it is as important as finding the most reliable variables to predict the return of the market.

Difficulties in Implementation

Why doesn’t everyone try to time the market? Wouldn’t it be nice to avoid 2008? When will the next market break come? Is it possible to avoid it? There are a number of problems in the implementation of a tactical asset allocation program. First, the information is imperfect and comes at irregular frequencies. Second, one needs to continuously monitor factors that may or may not provide information about future returns. Third, one needs to optimally find the right mix of indicators, assess them and then trade immediately when there is a change of information. This process does not follow the schedule of a traditional investment committee that meets on the third Thursday following the end of the quarter. And the cost of just the information, let alone the staff to implement the strategy is prohibitive for most investors.

The discipline required reminds me of a card counter playing blackjack. The player must continually count the cards, play each deal perfectly and bet in a disciplined optimal way all the time. Few individuals have the discipline to act continually in an optimal way.

John Cochrane, a professor of finance at the University of Chicago Booth School of Business, suggests that a longer term strategy requires a person with a contrarian spirit. Having some experience in high frequency trading and blackjack, I know that you need to have complete faith in the system. When you start to implement the system you have to be willing to continue trading even if you are losing. Our simulation showed a $1.3 million draw down with a maximum of 100 contracts, and we shouldn’t start unless we believe in the system and are willing to take that drawdown before abandoning the system. Other investors should determine how much they wish to risk and adjust their positions accordingly

Products to Trade

Although we use the S&P 500 E-mini futures contract, other investors could easily use SPDRs (SPY) to establish long positions and an exchange traded fund like ProShares Short S&P 500 (SH) for short positions. We would expect any broad based index to perform in a similar manner to the simulation.

Academic Literature and Variables used in the Simulation

Research on this subject is voluminous. For a survey, see Creamers (2001). The literature is split regarding predictability of market returns. Goyal and Welsh (2008) *A Comprehensive Look at The Empirical Performance of Equity Premium Prediction* is most cited by detractors while Cochrane (2008) *The Dog That Did Not Bark: A Defense of Return Predictability* is often cited by believers.

Partial List of Variables Considered in the Simulation

1. Price to Earnings Ratio (PE): Before Graham and Dodd (1934) the PE was used as an indicator of value and Campbell and Shiller (1998) report that PE ratios explain as much as 40 percent of future returns. Here we use the price divided by the trailing 12 months earnings.

2. Cyclically Adjusted Price to Earnings Ratio (CAPE): Shiller (2000) creates CAPE which is price divided by the average inflation adjusted earnings over the past 10 years.

3. Bond Yield (BY): Pastor and Stambaugh (2007) suggested the 30 year bond yield divided by a 12-month moving average of the yield. We use the 10-year bond yield divided by the bond yield exponential moving average (alpha = 0.0167).

4. Sell in May and Go Away (SIM): Bouman and Jacobsen (2002) and Doeswijk (2005) believe that vacation timing and optimism for the upcoming year create lower returns during the summer months and higher returns moving into the coming year. We use Ziemba (2012) and sell on the second day in May and buy on the sixth trading day before the end of October.

5. Variance Risk Premium (VRP): Bollerslev, Tauchen and Zhou (2008) show that short to intermediate returns are predicted by VIX squared minus the previous month's variance as measured by five minute bars. We use VIX minus the volatility forecast from GARCH (1,1) using the open, high, low, close estimator by Yang & Zhang, (2002). We find that a moving average of the VRP is effective.

6. Baltic Dry Index (BDI): Bakshi, Panayotov, Skoulakis (2011) show that the three month change in the BDI predicts intermediate returns in global stock markets. We use a shorter term indicator.

7. New Orders/Shipments (NOS): Jones and Tuzel (2011) show that high levels of NOS forecast lower excess returns. This variable is subject to revision by the U.S. Commerce Department.

8. Consumer Price Index (CPI): Campbell and Vnolteenaho (2004) contend that stock mispricing can be explained by inflation. We use the CPI divided by a CPI exponential moving average (alpha = 0.003).

9. Moving Average (MA): Neely, Rapach, Tu and Zhou (2012) use principalcomponents analysis to show that a group of macro-economic variables best pick tops and a group of technical indicators best pick bottoms. We use a technical indicator made up of two moving averages. If the two-month moving average of price exceeds the 12-month moving average, the indicator takes on a value of one, else zero.

10. Dollar Index (DOL): Over the last 10 years the dollar and the S&P 500 have had a negative correlation. We find that this persistent correlation is not fully discounted in current prices.

11. High Yield Bond Index (HYBI): A variety of credit spreads are mentioned in the literature. The high yield index is a proxy for a credit spread.

12. Bond Prices (TENT): Cochrane and Piazzesi (2005) show that a single tent-shaped linear combination of forward rates with maturities of between one and five years can predict excess returns.

Concluding Remarks

Games come in a variety of forms. Some allow numerous decisions in a short amount of time. Blackjack provides 800 decisions per day (100 hands per hour times eight hours per day). High frequency trading provides the opportunity to make thousands of decisions per day. But neither blackjack nor high frequency trading provide the opportunity to deploy large amounts of capital. Timing the market does not give instant feedback or high Sharpe ratios but gives the investor an opportunity to draw from diverse sources of information and combine that information in an optimal way that will provide a more satisfying return structure in the long run. We intend to continue to trade with a maximum of 100 contracts until we have evidence that we should discontinue or increase our size.

Brian Von Dohlen and Rick Anderson contributed to this work.

[1]Rick Anderson, author of *Market Timing Models*, McGraw-Hill, 1996.