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How You Could Have Made Money In Equities In The Bear Market Of 2000-2002

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The three calendar years of 2000, 2001 and 2002 severely tested the resolve of investors to remain in the stock market. For these three years, the S&P 500 total return index was down by -9.09%, -11.88% and -22.11%, respectively. Investors with self-imposed or regulatory restrictions that required the majority of their portfolios be in stocks, faced a difficult challenge to obtain positive portfolio returns.

This paper investigates whether there was any non-shorting procedure to keep a large portion of a portfolio in stocks and still obtain positive returns for each of these three difficult years. We will also keep an eye on what would have happened to the average return of the portfolio during the bull market years of 1991-1999. Following any procedure, it would be desirable not to lose too much of the returns available from stocks during the first interval.

Using Modern Portfolio Theory and Bonds

We shall first consider the admonition of Harry Markowitz to diversify a portfolio using Modern Portfolio Theory in order to reduce losses. Luckily, long-term government bonds had positive returns for each of the three difficult years. Based on annual holdings as shown in Table 1, an allocation to bonds of 65.5% is required to obtain zero or better portfolio returns for each of 2000, 2001 and 2002.

This result indicates that diversifying with bonds obtains non-negative returns for years 2000-2002. However, holding a constant 65.5% allocation in bonds over the entire interval from 1991 to 2003 has other unfortunate effects. The average portfolio return during 2000-2002 is only a modest 2.0%. While this is certainly not a negative number, it is less than interest rates. In addition, the average portfolio return from 1991 to 1999 is only 12.35%, far less than the 20.85% of stock returns.

Using Modern Portfolio Theory on this two-investment portfolio offers little help. Increasing the allocation to bonds in order to increase the returns during 2000-2002 would result in reducing the returns for 1991-1999.

Adding Additional Traditional Investments

For constant allocation portfolios, only investments with average returns above zero during 2000-2003 and average returns not too far below the stock market return of 20.85% for 1991-1999 would achieve our goal. The risk-reduction available from Modern Portfolio Theory offers no help if the investments do not have the necessary historical returns. Traditional investments that might be considered are non-U.S. stocks and bonds. The top 15 country stock indices for 2000-2002 average per-formance are shown in Table 2.

Table 1.
Stocks and Bonds by Year

Year	S&P500 Stock Return	U.S. Gov't. Bonds	34.5/65.5 Portfolio Returns
1991	30.47	15.31	20.54
1992	7.64	7.20	7.35
1993	10.08	10.70	10.49
1994	1.32	-3.35	-1.74
1995	37.59	18.29	24.95
1996	22.96	2.74	9.71
1997	33.38	9.64	17.83
1998	28.57	10.01	16.41
1999	21.03	-2.45	5.65
2000	-9.09	13.48	5.70
2001	-11.88	6.74	0.32
2002	-22.11	11.64	0.00
2003	28.69	2.27	11.38
Avg 91-99	20.85	7.34	12.35
Avg 00-02	-14.55	10.58	2.00

Table 2.
Non-U.S. Stocks by Country

Country	Average Stock Return 2000-2002
Australia	-2.37
New Zealand	-2.59
Norway	-6.36
Mexico	-6.50
Korea	-6.63
Switzerland	-8.91
Denmark	-9.19
Italy	-11.78
Chile	-12.87
Belgium	-13.59
United Kingdom	-13.62
Spain	-13.86
Ireland	-14.44
Portugal	-15.04
Netherlands	-15.55

Since none of these top performing country stock market returns are positive for 2000-2002, they cannot be used to lift a portfolio to a positive level. Unfortunately, stock market returns among countries have become increasingly correlated. Independence of stock market returns from country to country is no longer available as a useful portfolio construction device.

Are bond returns by country of any help? A similar exercise for foreign bonds with terms of 10-years or longer leads to the results shown in Table 3.

Table 3.
Non-U.S. Bonds by Country

Country	10-Year+ Gov't. Bond Return 1991-1999	2000-2002
Switzerland	5.37	13.56
Netherlands	6.21	12.02
France	8.71	11.73
Sweden	8.45	8.21
Canada	9.38	6.82
United Kingdom	11.45	6.29
Australia	10.53	6.28
Japan	13.44	1.23

In order to raise the 2000-2002 return above zero for a portfolio containing at least 50% U.S. stocks, the average return of the investments added must be at least 14.55%. None of the non-U.S. bond returns is greater than this level. If any of these non-U.S. bond indices were employed, they would substantially lower the return of a portfolio during the 1991-1999 interval since the S&P 500 averages 20.85% during this interval. The most useful of the non-U.S. bonds for 2000-2002 also had the lowest returns for 1991-1999.

We therefore reach the conclusion that fixed allocations of non-U.S. stocks or bonds would not be of any help in meeting our twin goals of obtaining positive returns during 2000-2002 and not losing too much of the 1991-1999 stock return average.

Adding Alternative Investments

If traditional investments were not capable of increasing the portfolio returns above zero, then perhaps the use of alternative investments would provide an answer. Indices of hedge fund categories are considered first. Table 4 shows the performance of 11 CISDM hedge fund categories for the two date ranges.

Table 4.
Hedge Fund Categories

Hedge Fund Categories	Hedge Fund Index Return for 1991-1999	2000-2002
Short-Sellers	-5.19	17.95
Market Neutral	11.51	9.54
Mkt Neutral: Long/Short	10.74	7.62
Distressed Securities	15.47	7.31
Event-Driven	14.50	6.85
Market Neutral: Arbitrage	16.32	6.52
Risk Arbitrage	15.31	6.15
Global Macro	15.69	6.09
Global Emerging	16.27	4.51
Global Established	21.00	1.65
Global International	15.06	0.74

The short-sellers index has a high enough return for the 2000-2002 interval to lift a portfolio return over zero. However, its negative 1991-1999 performance would cut the historical return by more than half of the S&P 500 return. The other hedge fund indices have too low a value for 2000-2002 to lift the portfolio above zero, unless the hedge fund index allocation is much greater than 50%.

It is well known that individual hedge funds are not strongly correlated within the same category of hedge funds. Perhaps there are individual hedge funds that can provide the desired performance features. Assuming that most investors would not commit more than 25% of their portfolio to individual hedge funds, the rate of return for a single fund to overcome the -14.55% annual return for stocks during the 2000-2002 interval needs to be 43.65% ($-14.55\times0.75 + 43.65\times0.25 = 0$). Among all the funds available on the HFR database with histories back to 1991, only three have an annual return average above 43.65% for 2000-2002. These three funds have average returns for 1991-1999 of -3.56%, 10.01% and 18.31%. Thus, only one fund has a large enough return for 1991-1999 to warrant consideration. Finding only one useful fund is not sufficient to suggest that individual hedge funds offer a workable solution to our problem.

Employing Stock Industry Sectors

One more possibility is feasible. Since our objective is to construct a portfolio that consists of more than 50% stocks, perhaps there is some fixed allocation to a group of stock sectors that provides a positive return during 2000-2002. This portfolio would also need to compare favorably to the S&P 500 during the 1991-1999 interval.

Historical performance data is readily available for Fidelity Select Funds which represents a reasonably large number of categories. For Fidelity Select Funds existing since 1991, performance is shown in Table 5 (next page) for the two time intervals. These Fidelity Select Funds provide ample opportunity to retain the average historical return for the S&P 500 during the 1991-1999 interval of 20.85%. Many of these funds also offer positive expected returns for the 2000-2002 interval. Funds with returns higher than 5.00% for 2000-2002 are highlighted in blue in Table 5.

On the other hand, many of the Fidelity Select Funds with high average returns for 1991-1999 have very poor performance in the 2000-2002 interval, especially the technology and communications sectors. A portfolio optimization based on Markowitz's mean-variance approach is applied to all of the funds in Table 5, plus a Fidelity government bond fund. The required expected returns, standard deviations and covariance matrix are calculated from the average performance during 1991-1999. In order to control out-of-sample risk, the individual allocations are limited to a maximum of 30%. A point is selected near the middle of the efficient frontier to further reduce the risk for the resulting portfolio. The optimized asset allocations are shown in Table 6 (next page), with all other funds receiving a zero allocation.

As might be expected, most of the investments receiving allocations are from the higher return portion of Table 5. Allocations to related sectors are restricted by the actions of the mean-variance process. For example, no allocation is given to the Technology sector because there is a 0.90 correlation between the technology sector and the electronics sector. The expected return of the portfolio based on the 1991-1999 interval is 26.20% and the expected standard deviation is 13.40%.

The out-of-sample results are another matter. The 2000-2002 yearly performance is shown in Table 7 based on the portfolio from the fixed allocations indicated in Table 6.

All three yearly portfolio returns are negative with values quite near the S&P 500 return. This portfolio constructed from expectations based on past averages does not perform well out-of-sample. In fact, any portfolio constructed from these funds based on averages from the 1991-1999 interval is doomed to have poor performance in the 2000-2002 interval because the high-flying technology stocks took a nose-dive in the latter interval. In addition, the five funds (Home Finance, Insurance, Real Estate, Medical Delivery and Gold) with the power to elevate the returns in the second interval were allocated a total amount of only 2.80% because of their modest-to-low returns during 1991-1999.

The problem does not lie with the Markowitz mean-variance model itself. The problem stems from the lack of a good procedure to formulate useful expectations of future performance. Past averages are poor predictors.

Dynamic Asset Allocation Approach

In 1993, Harry Markowitz recognized this problem of needing better expectations of future performance than could be obtained from simple historical averages. In Bloch, Guerard, Markowitz, Todd and Xu (1993), a procedure is outlined to employ expectations of equity performance based on linear factor models of important market factors that influence rates of return. This procedure only projects average returns and continues to use historical averages for both standard deviations and the covariance matrix. Yet the results of this study show the effectiveness of using forecasted performance to obtain portfolios that should perform better on an out-of-sample basis.

Instead of using the dynamic formulation described in Bloch (1993), the approach described in Oberuc (2003) will be applied. In this procedure, instead of formulating a linear factor model to predict the investment rates of return, a linear factor model called a DynaPorte model is created that directly controls the asset allocations. This procedure does not require the formation of expected returns, expected stan-

Table 5.
Fidelity Select Fund Performance

Fidelity Select Fund Performance	Fund Return 1991-1999	Fund Return 2000-2002
Electronics	41.47	-29.70
Technology	38.16	-33.98
Computers	37.54	-33.56
Developing Communications	35.38	-38.35
Software & Computer	35.29	-17.14
Brokerage and Investment Management	27.89	-1.23
Financial Services	26.63	1.14
Multimedia	26.53	-12.77
Telecommunications	26.42	-31.70
Banking	26.01	3.23
Home Finance	25.57	**13.03**
Leisure	25.05	-14.95
Retailing	23.08	-11.12
Biotechnology	22.37	-16.01
Stock Selector	21.50	-14.42
Health Care	21.38	-1.63
Industrial Equipment	20.37	-9.93
Transportation	20.14	1.47
Consumer Industries	19.32	-10.03
Utilities Growth	19.32	-22.25
Insurance	19.17	**11.21**
Air Transportation	18.31	-4.30
Defense and Aerospace	17.96	3.88
Construction and Housing	16.11	**6.13**
Paper and Forest Products	14.96	1.89
Chemicals	14.44	1.46
Automotive	13.82	2.13
Food and Agriculture	13.19	**6.45**
Real Estate Investment	12.23	**15.03**
Industrial Materials	12.03	0.98
Energy Service	11.48	**5.67**
Energy	10.06	0.89
Medical Delivery	9.56	**12.94**
Money Market	4.64	3.90
Gold	1.06	**18.93**
Environmental	0.10	0.65

Table 6.
Fidelity Select Fund Allocation

Fidelity Select Fund	Allocation
Banking	11.06
Electronics	23.11
Health Care	1.52
Home Finance	2.80
Multimedia	20.74
Retailing	3.96
Utilities Growth	30.00
Government Bonds	6.81

Table 7.
Mean-Variance Portfolio
Out-of-Sample Performance

Calendar Year	Portfolio Return	S&P 500 Return
2000	-7.27	-9.09
2001	-7.74	-11.88
2002	-25.34	-22.11

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dard deviations or an expected covariance matrix.

In a simplified example, assume that there are only three investments: stocks, bonds and T-bills. Also assume that there are two factors, stock dividend yield and bond yield, controlling the asset allocations to those three investments. We want to establish a set of linear allocation control functions that dynamically change the asset allocations as the control factors change. The asset allocations for time *t* might look like those shown in Table 8.

Notice that the allocations for time *t* are functions of past value of the control variables from time *t-1*. This lag makes the set of control functions operate in a forecasting manner. The coefficients utilized in the asset allocation control functions are obtained through a mathematical programming problem that minimizes the sum of portfolio loss months in the time interval used to determine the coefficients. Furthermore, in order to ensure that the sum of the asset allocations is always 100% at each month, the sum of the constant coefficients is always 100.00 and the sum of the coefficients for each factor is zero. For the details of constructing models of this form, see Oberuc (2003).

Once the coefficients of the model are obtained based on a past time interval, the asset allocation control functions can be used on a forecasting basis on an out-of-sample time interval. As each month ends, the values of the market or macroeconomic factors measured in that month are used to determine the time-varying asset allocations for the next month.

Table 8.
Asset Allocations for time *t*

$$\text{Allocation}_{\text{Stocks},\,t} = 13.06 + 30.09\ \text{Div Yield}_{t-1} - 10.82\ \text{Bond Yield}_{t-1}$$

$$\text{Allocation}_{\text{Bonds},\,t} = 19.04 - 15.65\ \text{Div Yield}_{t-1} + 9.02\ \text{Bond Yield}_{t-1}$$

$$\text{Allocation}_{\text{T-bills},\,t} = 67.90 - 14.44\ \text{Div Yield}_{t-1} + 1.80\ \text{Bond Yield}_{t-1}$$

Table 9.
Fidelity Select Fund Correlation Coefficients

Fidelity Select Fund	Ch	En	Fi	Go	He	Ho	Re	Te	Ut	Bd
Chemicals	1	0.56	0.63	0.29	0.39	0.60	0.49	0.45	0.38	0.09
Energy	0.56	1	0.42	0.40	0.22	0.40	0.37	0.32	0.47	0.21
Financial Services	0.63	0.42	1	0.14	0.56	0.89	0.45	0.49	0.60	0.34
Gold	0.29	0.40	0.14	1	0.13	0.21	0.21	0.23	0.24	0.07
Health Care	0.39	0.22	0.56	0.13	1	0.49	0.28	0.53	0.42	0.22
Home Finance	0.60	0.40	0.89	0.21	0.49	1	0.55	0.36	0.50	0.30
Real Estate	0.49	0.37	0.45	0.21	0.28	0.55	1	0.27	0.34	0.19
Technology	0.45	0.32	0.49	0.23	0.53	0.36	0.27	1	0.45	0.09
Utilities	0.38	0.47	0.60	0.24	0.42	0.50	0.34	0.45	1	0.42
Government Bonds	0.09	0.21	0.34	0.07	0.22	0.30	0.19	0.09	0.42	1
Average	0.43	0.38	0.50	0.21	0.36	0.48	0.35	0.35	0.42	0.21

Table 10.
Factors Used in Dynamic Model

- S&P 500 Dividend Yield
- 90-Day T-Bill Interest Rate
- Lagged S&P 500 Price Return
- Baa Corporate Bond Yield – 10-Year Government Bond Yield
- Manufacturing Capacity Utilization
- Industrial Capacity Manufacturing
- 5-Year U.S. Treasury Bond Yield
- Baa Corporate Bond Yield – Aaa Corporate Bond Yield
- Gross Domestic Product – Implicit Price Deflator
- Civilian Labor Unemployment Rate
- M3 Money Supply
- New York Stock Exchange Monthly Turnover
- Consumer Price Index for Urban Consumers
- Dividend Yields for Real Estate Stocks
- Dividend Yields for Mining Stocks

Dynamic Asset Allocation on Sector Funds

The large list of Fidelity Select Funds shown in Table 5 was evaluated to determine a shorter list of funds that have low correlation with one another for the time interval 1991-1999. If two investments have high correlation with one another, it would be redundant to include both investments in a portfolio. The correlation coefficients for Fidelity Select Funds with low historical relationship to one another is shown in Table 9. Regression analysis on the monthly returns of each of these funds revealed a list of common factors that seem to relate to the returns of the funds. This list of factors is shown in Table 10. DynaPorte models are constructed to determine the optimal asset allocation control functions for the Fidelity Select funds shown in Table 9. The unknown coefficients of the dynamic model are calculated using lagged values of the macroeconomic factors shown in Table 10.

A number of controls were established in determining these models. The dynamic asset allocations to the Fidelity Select Funds were limited to no more than 30% of the portfolio at each month (40% with leveraging). The allocation to government bonds was allowed to go as high as 60% when the factor model determined it was prudent to do so. A small amount of leverage was employed. An amount up to one-fourth of the portfolio could be borrowed, depending on a dynamic borrowing model using the same factors shown in Table 10. Borrowed funds were charged interest at 0.75% above the Broker Call Rate charged on margin. The portfolio was optimized by minimizing the monthly losses below zero when the target monthly return was 2.7%.

A sequence of such models were built based on an historic date range and then used out-of-sample to determine the allocations to employ for the next 12 months. This sequence of

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models was determined in the following manner.

1. Data from December 1986 to December 1990 was used to build a model that was evaluated out-of-sample for January 1991 to December 1991.
2. Data from December 1986 to December 1991 was used to build a model that was evaluated out-of-sample for January 1992 to December 1992.

   ⋮

3. Data from December 1986 to December 2002 was used to build a model that was evaluated out-of-sample for January 2003 to December 2003.

It is important to repeat that the out-of-sample dynamic asset allocations and the resulting portfolio performance determined by these models are evaluated on a forecasting basis. No data from the forecasted year is used to determine the model coefficients for that year. The time-varying allocation to the Fidelity Select Technology Fund is shown in Figure 1 as an example of the dynamic allocation process.

The asset allocations for each fund change each month as dictated by the asset allocation control functions. The return on the portfolio is then evaluated from these asset allocations and the monthly returns of the individual funds. The annual returns based on the sequence of dynamic models are shown in Table 11. A comparison is made against the performance of the S&P 500 total return index. While the annual return of the dynamic model was positive for every year, this is not necessarily indicative of every dynamic asset allocation model. The average annual return during the 2000-2002 interval was not only positive but was more than 27% above the average S&P 500 return. In addition, the returns of the dynamic model averaged 6% over the returns for the S&P 500 during the 1991-1999 interval. In 10 out of 13 years, the DynaPorte model outperformed the S&P 500 as highlighted in blue in Table 11. This is especially noticeable in the negative performance years for the S&P 500.

Evaluating the performance of the dynamic portfolio and the S&P 500 on a monthly basis leads to the statistical results shown in Table 12 over the entire interval from 1991 to 2003.

Figure 1.
Allocation to the Technology Fund

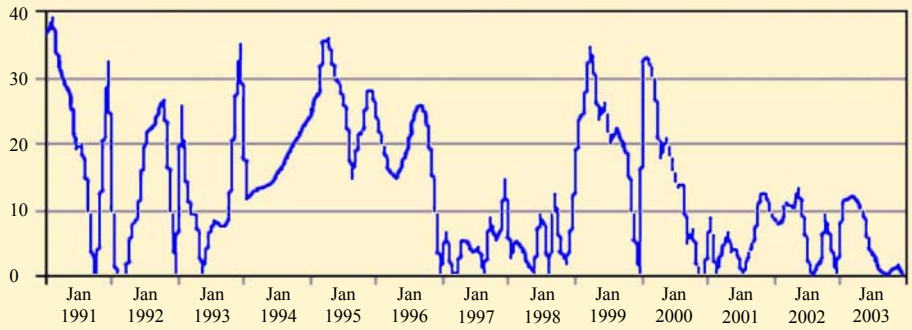

Table 11.
DynaPorte Portfolio Annual Returns Based on Out-of-Sample Results

Year	S&P 500 Stock Return	DynaPorte Portfolio Return	DynaPorte Minus S&P 500
1991	30.47	60.99	30.52
1992	7.64	16.66	9.02
1993	10.08	27.40	17.32
1994	1.32	1.39	0.07
1995	37.59	40.99	3.40
1996	22.96	22.60	-0.36
1997	33.38	30.50	-2.88
1998	28.57	19.95	-8.62
1999	21.03	29.48	8.45
2000	-9.09	26.00	35.09
2001	-11.88	0.53	12.41
2002	-22.11	13.16	35.27
2003	28.69	37.12	8.43
Avg 91-99	20.85	26.85	6.00
Avg 00-02	-14.55	12.75	27.30
Avg 91-03	12.10	24.19	12.09

Table 12.
DynaPorte Portfolio Statistics

Statistic	S&P500	DynaPorte Portfolio
Average Annual Return	12.10	24.19
Annual Standard Deviation	14.79	13.74
Average Deviation Below 0	1.24	0.82
Sharpe Ratio	0.37	1.28
Lowest Monthly Return	-14.46	-12.72
Maximum Drawdown	44.73	13.49

Conclusions

Our problem was to find a methodology that would provide a positive portfolio performance for each of the years 2000 to 2002, while keeping at least half the portfolio in stocks. None of the traditional methods for reducing portfolio risk seemed to help. Diversifying with full-market U.S. or non-U.S. stocks or bonds could not achieve our target. Employing a mean-variance portfolio model on stock market sectors was also not effective. Alternative investments such as hedge funds were not capable of helping us meet our goal unless very large allocations to these alternatives were employed.

It appears that only dynamic asset allocation was capable of achieving positive returns during the 2000-2002 interval. The dynamic models constructed also outperformed the

S&P500 during the earlier interval of 1991-1999 as well. The fact that all of the dynamic analysis was conducted on an out-of-sample basis suggests that dynamic asset allocation is a very promising methodology. ■

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Notes

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