

FOCUS ON

PORTFOLIO CONSTRUCTION

Laurent Favre, of AlternativeSoft, shares his theories on portfolio construction with equal volatility contribution



Laurent Favre

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One of the problems pension funds face is to deliver positive returns in the long term, using a diversified portfolio of equities, fixed income, hedge funds, private equity and infrastructure. The target portfolio annual return for a pension fund is between 2% (in Switzerland as of January 2010) and 7.5% (for a New York pension fund as of August 2010).

In order to reach that level of return, it is advised to build portfolios protecting the downside and financed by capping the upside, either with derivatives or highly diversified portfolios. In this article, we will focus on the latter technique.

There are different techniques to build highly diversified portfolios, each with their own pros and cons.

One example is a portfolio with an equal asset contribution to portfolio volatility. Pros include: no need to know the assets' expected returns and no concentration risk in the portfolio. The con is its low volatility, so low portfolio expected return. Using this technique, we can bypass the need to estimate an asset's expected returns and result, hopefully, in a diversified portfolio where an asset with high volatility or high correlation to the other assets will have a low portfolio weight¹.

We empirically show it is possible to generate a portfolio, which strategically (i.e. >=12 months), outperforms an equally weighted benchmark or a hedge fund index, by 1.96% per annum.

DATA

To build our portfolio, we invest in 10 indices: one fixed income index (Citigroup US 10 years), five hedge fund indices (HFR Convertible, HFR EH, HFR FI Corporate, HFR Macro, HFR RV)², one commodity index (DJ UBS Commodity Index) and three equity indices (MSCI Switzerland, MSCI Europe, S&P500). Data are from January 1991 (inception date for DJ Commodity Index) to July 2011.

After 12 months³, the portfolio is rebalanced to ensure each asset contributes equally to the portfolio volatility. No transactions costs are taken into account.

Our objective is to build a portfolio with the following conservative objectives:

a) Outperform out-of-sample the following five benchmarks:

- An equally weighted portfolio, called BM1
- The HFRI FoHF index (USD), called BM2
- The minimum volatility portfolio, called BM3
- The minimum MVar 99% portfolio, called BM4
- The S&P500, called BM5;

b) Generate at least 5% per annum from January 1996 to July 2011⁴;

c) Have positive returns every year from January 1996 to July 2011.

TABLE 1: INDICES STATISTICS 1996-2011

	Annualised return	Annualised volatility	Annualised return during bull market	Annualised return during bear market
Citigroup US Treasury 10 Years TR	5.49%	7.55%	1.84%	11.39%
Dow Jones UBS Commodity Index	2.72%	16.42%	12.60%	-10.89%
HFR Convertible Arbitrage	8.47%	7.54%	15.53%	-1.62%
HFR Equity Hedge	10.56%	9.58%	30.36%	-14.33%
HFR Fixed Income Corporate	6.28%	6.00%	14.26%	-5.00%
HFR Macro	8.57%	6.45%	15.45%	-1.27%
HFR Relative Value	8.68%	4.50%	14.53%	0.20%
MSCI Europe NR USD	7.52%	18.52%	50.36%	-36.02%
MSCI Switzerland NR USD	7.83%	17.45%	38.29%	-26.64%
S&P 500 TR (as reference)	6.94%	16.15%	52.35%	-38.17%
HFR Fund of Funds (as reference)	6.05%	6.25%	15.73%	-7.37%

Source: HFR, Morningstar, AlternativeSoft, data from January 1996 to June 2011, bear market refers to S&P500 negative monthly returns dates.

TABLE 2: BENCHMARKS AND PORTFOLIO OUT-OF-SAMPLE WEIGHTS

	BM1 (1)	BM2 (2)	BM3 (3)	BM4 (4)	Portfolio average weights (5)
Citigroup US Treasury 10Y TR	10%		8%	15%	17%
Dow Jones UBS Commodity	10%		4%	1%	7%
HFR Convertible Arbitrage	10%		27%	19%	17%
HFR Equity Hedge	10%		0%	0%	7%
HFR Fixed Income Corporate	10%		7%	9%	13%
HFR Macro	10%		7%	10%	10%
HFR Relative Value	10%		47%	45%	17%
MSCI Europe NR USD	10%		0%	0%	4%
MSCI Switzerland NR USD	10%		0%	1%	4%
S&P 500 TR	10%		0%	0%	4%
HFR Fund of Funds		100%			
Total	100%	100%	100%	100%	100%

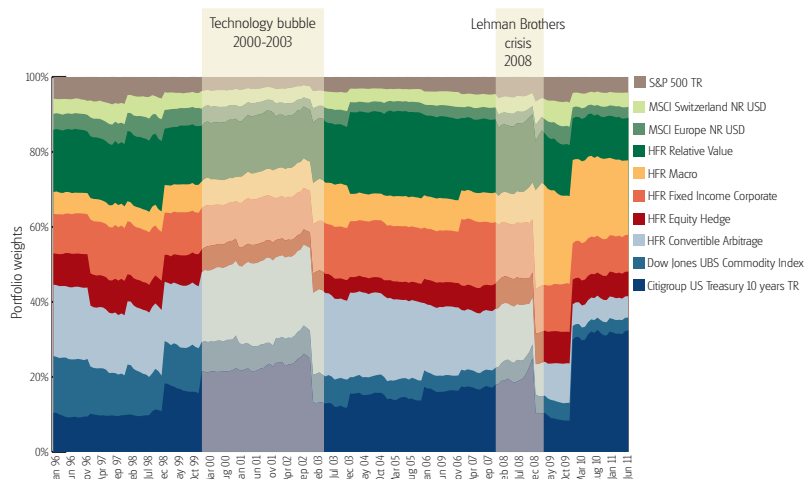
Note: BM1 is equally weighted. BM2 is the HFRI FoHF Index. BM3 is the min volatility portfolio. BM4 is the min MVar portfolio. Benchmarks and portfolio are rebalanced every 12 months. Column (5) displays the average weights from each equal volatility contribution optimisation. An optimisation is performed every 12 months.

TABLE 3: BENCHMARK AND PORTFOLIO OUT-OF-SAMPLE STATISTICS

	BM1 (1)	BM2 (2)	BM3 (3)	BM4 (4)	S&P500 (5)	Portfolio (6)
Annualised return	7.98%	6.04%	6.80%	6.51%	4.87%	7.60%
Annualised volatility	7.61%	6.24%	4.40%	4.55%	16.12%	5.29%
Skewness	-1.27	-0.72	-3.47	-2.88	-0.66	-2.02
Correlation to S&P500	0.83	0.60	0.52	0.43	1.00	0.70
Max monthly loss	-10.82%	-7.47%	-8.85%	-7.70%	-16.94%	-8.86%
Maximum drawdown	-29.13%	-22.20%	-19.34%	-17.41%	-52.56%	-20.34%
Annual Sharpe ratio	0.62	0.69	0.82	0.73	0.08	0.83

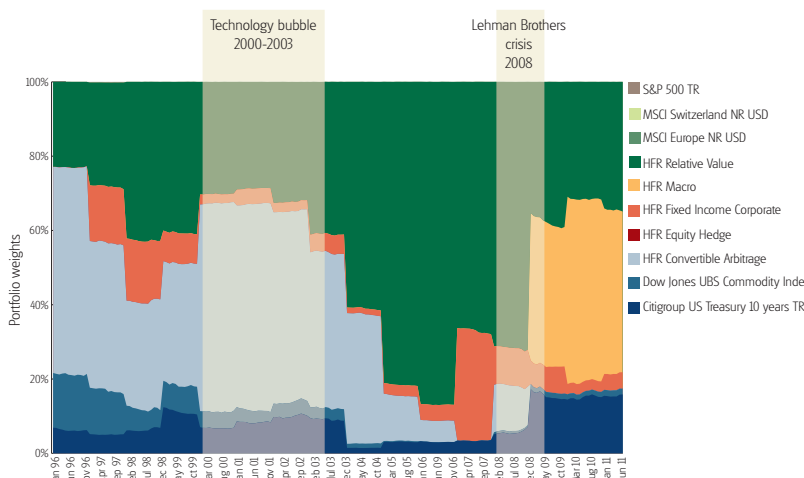
Source: AlternativeSoft. Data from January 1996 to July 2011. BM1 is equally weighted. BM2 is the HFRI FoHF Index. BM3 is the min volatility portfolio. BM4 is the min MVar portfolio. Benchmarks and portfolio are rebalanced every 12 months.

GRAPH 2a: OUT-OF-SAMPLE PORTFOLIO WEIGHTS



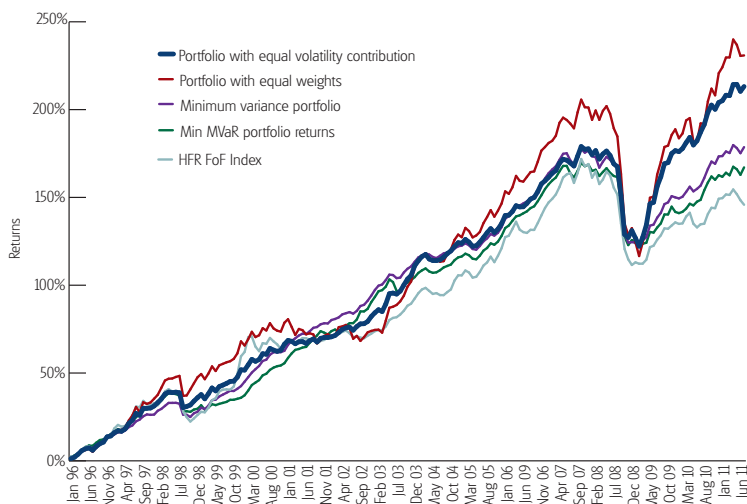
Note: Technology bubble from Jan 2000 to Feb 2003. Lehman Brothers crisis from November 2007 to February 2009.

GRAPH 2b: OUT-OF-SAMPLE MIN-VARIANCE PORTFOLIO WEIGHTS



Note: Technology bubble from Jan 2000 to Feb 2003. Lehman Brothers crisis from November 2007 to February 2009.

GRAPH 3: CUMULATIVE OUT-OF-SAMPLE PORTFOLIO RETURNS



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RESULTS

Table 1 displays the indices' standard statistics. Four indices protect during bear S&P500 returns (i.e. Citigroup US Treasury, HFR CA, HFR Macro, and HFR RV).

Table 2, column (5), displays the portfolio average weights for the period 1996 to 2011 using the equally volatility contribution technique. On average, four indices are overweighted (see green bold values in Table 2) versus the equally weighted portfolio⁵.

Table 3, column (6), exhibits the out-of-sample statistics for the portfolio with equal volatility contribution. The portfolio annualised out-of-sample return is 7.60%, which is lower than the equally weighted benchmark 1 (7.90%) and higher than the HFR FoHF index (6.04%). The portfolio annualised volatility, max monthly loss and max drawdown are almost equal or better than the other five benchmarks. We found that by applying leverage to have the same volatility between BM1 and the portfolio, the portfolio annual outperformance versus BM1 was 1.96%⁶. We measured that this 1.96%⁷ outperformance was due to portfolio strategic overweights in hedge funds and fixed income rather than due to the portfolio equal volatility contribution rebalancing technique. This means this portfolio construction technique builds good strategic portfolios (i.e. 12 months or more), but does not build good tactical portfolios (<12 months).

Graph 2a exhibits the portfolio weights rebalanced every 12 months. For example, we see a large increase in Citigroup bond and macro weights in January 2010. Graph 2b exhibits that the minimum volatility portfolio is less diversified than the equal volatility contribution portfolio (i.e. graph 2a). Graph 3 shows the portfolio (bold blue line) underperformed the equally weighted benchmark from 1996 to 2002 and that the portfolio slightly outperforms the three other benchmarks (min volatility portfolio, minimum MvAR portfolio, HFR FoHF index).

CONCLUSION

The proposed portfolio construction technique is an equal volatility contribution technique. It allows building of well-diversified strategic portfolios, but is not recommended for tactical portfolios (when horizon <12months). However, with this technique, we have not been able to reach our three objectives:

- a) Outperform out-of-sample four of our five benchmarks has been achieved;
- b) Generate at least 5% per annum has been achieved;
- c) Have positive returns, every year, from 1996 to 2011 has not been achieved.

Using the same portfolio construction technique, our next research will focus on directly investing in hedge funds and mutual funds in order to outperform an equally weighted portfolio and on building portfolios with equal volatility contribution between funds. ■

1 This is not the same as the minimum volatility portfolio where assets with high volatilities are excluded.
 2 In an ad-hoc test, we replace HFR Equity Hedge by Barclay CTA and found the same results (i.e. same outperformance and negative portfolio return in 2008).
 3 We tested with six months rebalancing and found an outperformance of 1.57% after leverage costs. This means annual outperformance are almost identical between six months (1.57%) and 12 months (1.96%) rebalancing.
 4 Our first data point is Jan 1991, plus 60 months to compute the optimal equally volatility portfolio, which gives Jan 1996. 5% is the average between a Swiss and a New York pension fund target annual return.
 5 Nothing new here. The portfolio construction technique favours low risk assets.
 6 After US\$3m Libor borrowing cost.
 7 To test the robustness of the 1.96% annual outperformance, we used six months rebalancing and found an annual outperformance above an equally weighted benchmark of 1.57%. In addition, we used other indices and found an annual outperformance above an equally weighted benchmark of 0.94%.