A Risk Based Approach to Tactical Asset Allocation

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ABSTRACT

Faber's "*A Quantitative Approach to Tactical Asset Allocation*" (2009) proposes the use of a very simple trading rule to improve the risk-adjusted returns across various asset classes. The purpose of this paper is to present an alternative and simple quantitative risk based portfolio management that improves the risk-adjusted portfolio returns across various asset classes. This approach, based on the conclusions of Brandolini D. – Colucci S. "*Backtesting Value-at-Risk: A comparison between Filtered Bootstrap and Historical Simulation*", has been tested since 1974 for calibration and since 2000 in a real backtest. The asset allocation framework is using a combination of indices, including the Standard&Poors 500, Topix, Dax, MSCI United Kingdom, MSCI France, Italy Comit Globale, MSCI Canada, MSCI Emerging Markets , RJ/CRB, Merril Lynch U.S. Treasuries, 7-10 Yrs , and all indices are expressed in US Dollar. Since 2000 the empirical results present equity-like returns with lower volatility and drawdown and only one negative year both in gross and net of costs returns.

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INTRODUCTION

Many global asset classes in the 20th Century have produced spectacular gains in wealth for individuals who bought and held those assets for generational long holding periods. In this sense the United States and Great Britain have been rather unique, since their equity and bond markets have operated continuously throughout the previous century.

However, most of the common asset classes have experienced painful drawdown and others even a complete destruction of wealth. Indeed, many investors can still remember the horrific 40-80% declines they faced in the aftermath of the global equity market collapse only a few years ago, and many stocks across the globe have seen a 100% drawdown and loss of all capital. Investing in US stocks in the late 1920s and early 1930s, in any German asset class in the 1910s and 1940s, in US Real Estate in the mid 1950s, in Japanese stocks in the late 1980s, and in Emerging Markets and Commodities in the late 1990s was definitely not the best course of action.

Modern portfolio theory postulates that the volatility and drawdown associated with the afore mentioned capital markets is the trade-off an investor must accept to achieve corresponding levels of return. In "*A Quantitative Approach to Tactical Asset Allocation*" M. Faber proposes the following very simple trading rule for asset allocation on a risky and a risk-free asset: if the monthly close price of the risky asset is higher than its ten-month simple moving average, buy the risky asset; else buy the riskless asset. This simple timing model applied to each asset of a diversified portfolio including United States stocks, the Morgan Stanley Capital International EAFE Index (MSCI EAFE), Goldman Sachs Commodity Index (GSCI), National Association of Real Estate Investment Trusts Index (NAREIT), and United States government 10-year Treasury bonds leads to rather impressive results (better risk adjusted performance than a reference equally-weighted yearly rebalanced passive portfolio and especially a drastic reduction of the maximum drawdown).

In "*A quantitative approach to Faber's tactical asset allocation*" Marmi S., Pacati C., Renò R. and Risso W.A. say that Faber's approach is not a counterexample of market efficiency. They make some extensive analysis arguing that using some Bootstrapping procedure the Faber's results are so not exciting. They forget that market returns are not at all "random", they show volatility cluster (Maldelbrot 1963) and present two alternative states well known in literature as "Bull" and "Bear". Moreover investors see only one path and do not care about "simulated" path.

We would propose a new way to deal with risky assets knowing that volatility cluster exists. Table 1 presents the risk and return figures for ten asset classes since 1972 that will be examined in this paper and they all experienced rather significant drawdown. Data are total return since it is available, price return before[1].

data since 12/31/71 to 08/22/2011	S&P500	TPX	DAX	MXGB	MXFR	COMIT	MXCA	MXEF	CRYTR	G4A0
Annualized Return	7.76%	7.85%	7.84%	8.27%	7.39%	11.31%	7.37%	13.37%	11.77%	7.03%
Annualized Volatility	17.55%	20.81%	22.35%	17.32%	19.81%	23.83%	18.38%	18.70%	16.54%	7.51%
Return Risk	0.44	0.38	0.35	0.48	0.37	0.47	0.40	0.71	0.71	0.94
MaxDD	-55.25%	-64.40%	-69.11%	-72.40%	-60.35%	-69.56%	-60.57%	-73.36%	-57.46%	-27.19%
Ulcer index	16.42%	29.37%	24.52%	22.76%	18.82%	28.47%	20.38%	25.64%	18.52%	5.48%
Min Rolling Annual Return	-47.44%	-42.05%	-63.87%	-58.15%	-53.93%	-63.53%	-55.10%	-65.08%	-51.11%	-21.00%
Max Rolling Annual Return	71.98%	140.75%	156.57%	98.83%	77.40%	328.31%	102.05%	246.56%	128.17%	43.30%

Table I – Asset class returns since 1972: table shows a complete figure of risk and reward across ten asset class.

[1] For description of data sources and asset classes utilized in this paper, refer to Appendix A. All data have daily base.

This paper presents a quantitative risk based approach, named Stable Expected Shortfall (ES Stable), that improves risk-adjusted returns in every asset class tested. The methodology uses asset classes including the Standard & Poors 500 Index (S&P500), Topix Index (TPX), Dax Index (DAX), MSCI United Kingdom Index (MXGB), MSCI France Index (MXFR), Italy Stock Market BCI Comit Globale (COMIT), MSCI Canada (MXCA), MSCI Emerging Markets (MXEF), RJ/CRB Total Return Index (CRYTR), Merrill Lynch Unsubordinated U.S. Treasuries/Agencies, 7-10 Yrs (G4A0), all indices are expressed in US Dollar. It is calibrated up to 12/31/1999 (the model we use to estimate risk was published in 1999) and backtested in real world since 01/01/2000.

A. THE QUANTITATIVE RISK BASED SYSTEM: ES STABLE

In deciding on what process to use, few criteria are necessary for creating a simple model that investors can follow, and enough quantitative for removing every emotion in decision-making. They are:

1. Simple, non-optimized, purely mechanical logic.
2. The same model for every asset class.
3. Risk based only.

Faber 2009, use Single Moving Average of the price over last 10 month as decision rule for investing or not.

In this paper we would use an alternative Faber's indicator as Expected Shortfall to tune the risky asset in portfolio.

Investment rule for a single asset class:

- Set up your ES target (ES^T) (we set ES5% 1 month Horizon = -6%);
- Each five markets working days calculate ES (ES^C);
- If Calculated ES is greater then ES target then invest 100% in a risky asset;
- Else invest $\frac{ES^T}{ES^C} \cdot \left(\frac{1.41}{\frac{VaR1\%}{VaR5\%}} \right)^2$ in risky asset and the 1 complement in risk free asset

  (we invest in U.S. Treasuries 7-10 Yrs for all asset except for Commodity, for which we invest in US cash);

Note that the VaR ratio, in Normal assumption is 1.41 so if we estimate fat tail we have a ratio greater than 1.41 and we square a number less than 1. This correction helps us to reduce quickly the investment in risky asset when our future risk estimation shows warnings.

We would point out some considerations before to go ahead:

1. All entry and exit prices are on the day of the signal at the close.
2. Cash returns are estimated assuming interest rate on bank deposit equal to 75% of FED Funds Target Rate.
3. Taxes, commissions, and slippage are excluded for single asset classes.[2]

[2] A Total Expense Ratio equal to 2% per annum will be added to the managed asset allocation portfolio and a TER of 0.60% per annum to the buy & hold asset allocation portfolio.

B. EXPECTED SHORTFALL AS RISK MEASURE AND PORTFOLIO TUNER

To show the logic and features of our model, we tested ES Stable over the whole dataset until 1999. We would test if ES can mitigate Drawdown and improve return while reducing risk.

Expected Shortfall or Conditional VaR is a coherent risk measure as shown in ADEH (1998). It has such good propriety like, Monotonicity, Sub-additivity, Positive homogeneity and Translation invariance.

We would discuss briefly how we define this quantity $\frac{ES^T}{ES^C} \cdot \left(\frac{1.41}{\frac{VaR1\%}{VaR5\%}} \right)^2$ (more details in Colucci S. (2011)).

Sub-additivity and Positive homogeneity can be replaced by the notion of convexity such that:

$$ES(\lambda Z_1 + (1-\lambda)Z_2) \le \lambda ES(Z_1) + (1-\lambda)ES(Z_2) \tag{1}$$

Where $\lambda \in [0,1]$ and Z_i is a measurable random variable.

If Z_2 is a free risk asset and Z_1 is the risky asset then the (1) becomes:

$$ES(\lambda Z_1 + (1-\lambda)Z_2) \le \lambda ES(Z_1). \tag{2}$$

Now the portfolio's risk comes out only by the portion invested in risky asset Z_1 which is also the upper bound[3]. In our analysis we know how much risk we desire in our portfolio and we can fix the maximum risk that we can suffer as

$$ES(\lambda Z_1 + (1-\lambda)Z_2) \leq \lambda ES(Z_1) + (1-\lambda)ES(Z_2) = ES^T \ . \qquad (3)$$

Solving the equality in (3) with respect to λ recalling that Z_2 is a free risk asset and $ES(Z_2) = 0$ we get

$$\lambda = \frac{ES^T}{ES^C} .$$

According to this result we have to choose λ as the ratio between portfolio ES and risky asset ES. We use a correction factor $\left(\frac{1.41}{\frac{VaR1\%}{VaR5\%}}\right)^2$ in order to have a lower λ for taking into account the fact that markets move faster when risk is going up and therefore we would accelerate our disinvestment in that situation, in order to save part of our portfolio. In general way the correction factor is not necessary to achieve the upper bound of portfolio risk.

Maillard – Roncalli – Teiletche 2009 compare an equally-weighted risk contributions (ERC) portfolio with an Equally Weighted Portfolio ("*1/n*") and minimum variance portfolio (the unique mean-variance efficient portfolio independent of return expectation). They conclude that an ERC portfolio is similar to a minimum variance portfolio but less concentrated in few assets. To achieve the equally risk contribution is time consuming without the assumption of constant correlation between assets, so they work equalizing volatility contribution but it can

[3] We use upper bound of risk to indicate the maximum acceptable risk, it may be a bit confusing, but if you thing that risk increase when ES tends to minus infinity then our statement is true. We would set up an upper bound of risk that we can accept into the portfolio.

be shown that the total risk can be decomposed into components if the risk measure is linear-homogeneous in the weights. Because Expected Shortfall is a linear positive-homogeneous function, it is possible to equalize the risk contribution of any asset to the whole risk. Let's try to equalize the risk among the asset according our risk measure. Because we are worried only about upper bound, we can state that: *if any risky asset weight in portfolio is coherent with the upper bound limit, then his contribution to the upper bound risk is defined by its asset allocation portfolio weight.*

For instance consider 3 risky asset and 1 risk free asset, choose $ES^T = -10\%$ and calculate the ES of any asset (i.e. -30%, -20%, -10%). The coherent weights (forget about correction factor) of each risky asset are 33.3%, 50% and 100%. Now if we have an Equally Weighted asset allocation portfolio ("*1/n*") each maximum asset weight is 1/3 and each asset is fully invested if and only if its risk is less than the upper bound risk. In this example the final portfolio weight for each asset are 11.1% (1/3*33.3%), 16.7% (1/3*50%) and 33.3% (1/3*100%). ES contribution is defined by the product between portfolio weight and ex-ante forecasted ES so each asset contribute for -3.33% to the total risk, that is 1/3 of the total upper bound risk.

In order to estimate Expected Shortfall we use a Filtered Bootstrap approach (see Barone-Adesi G., Giannopoulos K., Vosper L. (1999), Brandolini, D., Pallotta, M., Zenti, R. (2000) Brandolini D. , Colucci S (2011)), to calculate ex ante ES 5% on one month horizon for each index. Each five working days we get our ex ante ES and obtain the risky asset weight to invest for the next week. We use as free risk asset the US Treasury/Agencies, 7-10 Yrs

(G4A0) as a safe investment except in a case of Commodity index in which case we use a synthetic bank account.

In Table II we report a tail indicator to show that no risk control is dangerous while our simple ES Stable model can force realized tail return to expected tail return. In particular this method reduces the absolute value of ES ex post for all indices, and reduce also the distance to the ES target (-6%) as shows ES Excess factor column, which is the ratio between ES realized and ES target. As we see in Table III and Table IV, in eight indices the Return Risk is pushed up by using ES Stable model; only in one case (MXCA) the ratio doesn't increase but both Max Draw Down (MDD) and Ulcer Index[4] signal reduction in heavy risk. MDD and Ulcer Index are squeezed by using a quantitative risk based system. This little backtest shows that it is possible to achieve similar returns while risk is maintained under control. Looking at Table V we can see that the number of solar year with negative performance is lower adopting a risk based approach and also the average negative return in those years are smaller.

	No Risk Based System			Risk Based System		
data since 12/31/73 to 08/22/2011	% 1M Rolling Retuns less the ESt	ES realizied 1 M	ES Excess Factor	% 1M Rolling Retuns less the ESt	ES realizied 1 M	ES Excess Factor
S&P500	6.45%	-9.60%	1.60	1.18%	-7.50%	1.25
TPX	11.76%	-9.24%	1.54	2.76%	-7.79%	1.30
DAX	10.50%	-10.67%	1.78	1.97%	-7.74%	1.29
MXGB	9.36%	-9.96%	1.66	2.78%	-8.63%	1.44
MXFR	9.10%	-10.04%	1.67	1.66%	-7.92%	1.32
COMIT	14.16%	-10.39%	1.73	2.68%	-8.38%	1.40
MXCA	9.54%	-10.13%	1.69	2.64%	-8.51%	1.42
MXEF	12.01%	-10.86%	1.81	2.79%	-8.48%	1.41
CRYTR	6.91%	-9.08%	1.51	2.10%	-7.27%	1.21

Table II – Asset Class realized Expected Shortfall and percentage occurrence: using a risk based system risk (ES Stable) measure improves and realized ES in one month is close to expected.

[4] Ulcer Index measures the depth and duration of percentage drawdowns in price from earlier highs. The greater a drawdown in value, and the longer it takes to recover to earlier highs, the higher the UI. Technically, it is the square root of the mean of the squared percentage drawdowns in value. The squaring effect penalizes large drawdowns proportionately more than small drawdowns.

data since 12/26/73 to 12/31/1999	S&P500	TPX	DAX	MXGB	MXFR	COMIT	MXCA	MXEF	CRYTR
Annualized Return	12.69%	11.80%	13.20%	13.46%	11.50%	15.94%	6.94%	13.04%	9.98%
Annualized Volatility	15.50%	19.49%	19.76%	14.51%	16.21%	23.49%	14.77%	16.32%	15.29%
Return Risk	0.82	0.61	0.67	0.93	0.71	0.68	0.47	0.80	0.65
MaxDD	-37.60%	-60.45%	-44.06%	-57.24%	-39.12%	-54.55%	-50.87%	-62.66%	-41.99%
Ulcer index	9.25%	22.98%	16.30%	13.23%	10.19%	26.16%	17.52%	19.07%	17.29%
Min Rolling Annual Return	-31.57%	-41.04%	-29.70%	-55.09%	-29.01%	-38.42%	-47.30%	-60.67%	-30.34%
Max Rolling Annual Return	59.07%	140.75%	156.57%	98.83%	69.34%	328.31%	88.99%	105.00%	65.89%

Table III – Asset Class risk figures with no risk procedure until 2000: all indices show high risk as MDD and Ulcer Index and worst annual return.

data since 12/26/73 to 12/31/1999	S&P500	TPX	DAX	MXGB	MXFR	COMIT	MXCA	MXEF	CRYTR
Annualized Return	9.78%	11.71%	12.10%	11.79%	10.83%	12.71%	4.70%	11.49%	9.80%
Annualized Volatility	10.43%	10.89%	11.03%	10.02%	9.74%	12.30%	10.18%	9.47%	10.57%
Return Risk	0.94	1.08	1.10	1.18	1.11	1.03	0.46	1.21	0.93
MaxDD	-20.62%	-29.88%	-36.12%	-43.58%	-21.64%	-36.63%	-31.25%	-34.15%	-36.46%
Ulcer index	5.79%	10.03%	10.20%	10.57%	5.95%	11.27%	11.70%	9.02%	9.87%
Min Rolling Annual Return	-15.19%	-24.32%	-26.10%	-41.05%	-15.54%	-21.72%	-20.69%	-31.02%	-28.00%
Max Rolling Annual Return	49.76%	98.78%	95.02%	61.70%	66.06%	111.82%	61.91%	85.21%	46.57%

Table IV – Asset Class risk figures using quantitative risk based system (ES Stable) until 2000: all indices show less risk measure as MDD and Ulcer Index and worst annual return

.

Solar Years from 1974 to 1999	S&P500	TPX	DAX	MXGB	MXFR	COMIT	MXCA	MXEF	CRYTR
Negative years	4	8	7	5	7	8	9	7	7
Negative years Risk Based	3	6	6	4	6	6	8	6	8
% negative years	15.38%	30.77%	26.92%	19.23%	26.92%	30.77%	34.62%	26.92%	26.92%
% negative years Risk Based	11.54%	23.08%	23.08%	15.38%	23.08%	23.08%	30.77%	23.08%	30.77%
Average Return in Negative Years	-13.51%	-17.24%	-11.00%	-18.31%	-8.99%	-13.07%	-11.72%	-21.52%	-14.26%
Average Return in Negative Years Risk Based	-8.85%	-10.58%	-5.12%	-17.44%	-6.32%	-4.59%	-8.92%	-7.22%	-7.61%
Average Return in Positive Years	15.67%	20.47%	18.39%	20.03%	15.02%	25.38%	12.32%	23.74%	15.43%
Average Return in Positive Years Risk Based	11.21%	15.36%	13.74%	15.95%	12.75%	14.92%	7.93%	14.31%	13.10%

Table V – Solar Years statistics: the comparison between the methods show an evident cut in the negative tail.

C. SYSTEMATIC TACTICAL ASSET ALLOCATION (From 2000)

In this section we apply the same considerations as in the previous section. We start from January 1st 2000 until August 22nd 2011. We present the same analysis on each asset class and we define a portfolio using the whole avaible asset class.

We invest our portfolio 70% in Equity, 10% in Commodity and 20% in US Treasury 7-10yrs. Commodity and Treasury have fixed weight in portfolio, while equity investment is derived by using GDP as driver of the asset class weight. In fact GDP figures tend to be more stable over time compared to equity markets' performance-related peaks and troughs, GDP weighted asset allocation tends to have higher exposure to countries with above average economic growth, such as emerging markets, and, finally, GDP weighted indices may underweight countries with relatively high valuation, compared to market-cap weight indices. This approach is recently gaining momentum in the light of increasing diversification and seeking a better exposure at growing markets (H. Jacobs, S. Müller, M. Weber 2010, MSCI Research Paper 2010).

We invest in each equity markets according to the percentage that each country has on World GDP , in particular every 5 years we compute a mean of past 5 years GDP for each asset class.

We should remember the subadditivity property of Expected Shortfall, then if we sum the weighted ES of each asset in portfolio we obtain the upper bound for our asset allocation portfolio. So we set an ex ante ES equal to -6% on one month horizon, for each asset class we expect that -6% is an upper bound for tail risk in the whole portfolio.

This assumption is straightforward to let us forget correlation or co-dependency between assets. In the worst case we obtain the risk fixed in advance, in the other cases we reduce the risk.

In table VI and VII, we report figures that show how the ES Stable improves both performance and risk, MDD and Ulcer Index are very small with respect to the index value. With respect to solar year returns, see Table VIII, we note that the number of negative returns is reduced when ES Stable is used and also that the amount of annual loss is constrained. Therefore, to specify an ES Target level may lead to an efficient frontier. Using these building blocks to construct our Asset Allocation Portfolio, we expect to reach better risk adjusted returns. In Figure 1, 2, 3 and 4, we report the single asset performance chart comparing with the respective when ES Stable is used. As data in Table *VII* suggest, we can really see how the model works. From 2000 to 2003 risk is increasing, markets go down and our model gets this information and provides to reduce market exposure, in each market (except Topix) wee can see roughly a strait line. In 2003 model gets reduction in risk and starts to buy risky asset until 2008, when markets collapse while ES Stable captures early signal and sells risky asset almost in time (the worst 2008 in equity markets was -53.33% in MSCI Emerging Markets while worst 2008 in Risk Based System is -5.03% in Comit). As we can see, ES Stable produces a very trendy and smoothed line.

data since 01/01/2000 to 08/22/2011	S&P500	TPX	DAX	MXGB	MXFR	COMIT	MXCA	MXEF	CRYTR
Annualized Return	-0.48%	-3.41%	1.05%	1.73%	0.28%	-0.99%	8.28%	8.48%	9.32%
Annualized Volatility	21.97%	23.93%	28.08%	23.06%	27.06%	24.91%	25.36%	21.62%	18.83%
Return Risk	-0.02	-0.14	0.04	0.08	0.01	-0.04	0.33	0.39	0.49
MaxDD	-55.25%	-60.57%	-68.63%	-63.63%	-60.35%	-69.56%	-60.57%	-65.24%	-57.46%
Ulcer index	22.95%	33.86%	32.96%	25.42%	27.84%	31.00%	26.25%	26.74%	22.17%
Min Rolling Annual Return	-47.44%	-42.05%	-54.58%	-56.47%	-53.93%	-63.53%	-55.10%	-65.08%	-51.11%
Max Rolling Annual Return	71.98%	79.59%	109.21%	81.55%	77.40%	86.54%	102.05%	118.20%	51.98%

Table VI – Asset Class risk figures with no risk procedure since 2000: all indices show high risk as MDD and Ulcer Index and worst annual return.

data since 01/01/2000 to 08/22/2011	S&P500	TPX	DAX	MXGB	MXFR	COMIT	MXCA	MXEF	CRYTR
Annualized Return	6.85%	2.81%	7.43%	7.64%	6.15%	7.56%	10.17%	8.51%	9.26%
Annualized Volatility	7.98%	11.51%	9.02%	9.06%	9.72%	9.76%	8.72%	7.00%	11.13%
Return Risk	0.86	0.24	0.82	0.84	0.63	0.77	1.17	1.21	0.83
MaxDD	-10.54%	-28.07%	-16.64%	-12.15%	-21.39%	-23.01%	-16.48%	-15.21%	-28.10%
Ulcer index	3.29%	11.33%	5.78%	4.29%	8.56%	7.39%	4.60%	3.74%	10.69%
Min Rolling Annual Return	-5.67%	-16.81%	-12.05%	-11.09%	-17.37%	-19.38%	-13.05%	-13.91%	-22.98%
Max Rolling Annual Return	24.87%	41.86%	30.70%	31.18%	29.29%	35.27%	36.98%	30.75%	33.67%

Table VII – Asset Class risk figures using ES Stable since 2000: all indices show less risk measure as MDD and Ulcer Index and worst annual return.

Year	S&P500		TPX		DAX		MXGB		MXFR	
	Index	ES Stable	Index	ES Stable	Index	ES Stable	Index	ES Stable	Index	ES Stable
31/12/2000	-9,10%	6,41%	-32,88%	-12,12%	-13,46%	0,34%	-12,93%	-1,09%	-4,32%	4,11%
31/12/2001	-11,89%	1,04%	-29,21%	-11,46%	-24,56%	-8,52%	-15,58%	-4,64%	-22,36%	-14,25%
31/12/2002	-22,10%	-0,66%	-8,51%	-0,27%	-33,54%	-0,23%	-14,37%	0,80%	-21,18%	0,04%
31/12/2003	28,68%	17,38%	38,44%	23,79%	64,03%	18,98%	33,84%	14,58%	40,22%	15,74%
31/12/2004	10,88%	5,29%	15,70%	8,58%	16,75%	15,18%	21,22%	19,45%	18,48%	12,88%
31/12/2005	4,91%	1,90%	26,82%	10,02%	10,26%	7,80%	9,49%	7,74%	9,88%	9,75%
31/12/2006	15,79%	13,05%	2,10%	2,25%	35,96%	22,84%	32,93%	29,93%	34,48%	19,45%
31/12/2007	5,49%	5,70%	-6,18%	3,96%	36,41%	20,92%	6,70%	8,27%	13,24%	14,30%
31/12/2008	-37,00%	4,36%	-25,82%	0,56%	-42,80%	-2,80%	-48,49%	-1,62%	-43,27%	-1,44%
31/12/2009	26,46%	3,54%	5,22%	-2,92%	25,82%	0,16%	44,16%	6,12%	31,83%	3,47%
31/12/2010	15,06%	15,06%	14,06%	15,09%	7,35%	9,49%	10,56%	6,69%	-4,11%	7,10%
22/08/2011	-9,51%	7,05%	-10,88%	0,30%	-14,12%	2,96%	-6,49%	5,95%	-11,51%	3,98%

Year	COMIT		MXCA		MXEF		CRYTR	
	Index	ES Stable	Index	ES Stable	Index	ES Stable	Index	ES Stable
31/12/2000	-1,73%	4,91%	5,34%	10,60%	-31,80%	-1,56%	31,87%	26,06%
31/12/2001	-27,88%	-16,29%	-20,43%	-2,53%	-2,61%	1,47%	-21,75%	-14,14%
31/12/2002	-7,38%	8,95%	-13,19%	-1,27%	-6,17%	9,80%	33,55%	22,71%
31/12/2003	40,84%	20,15%	54,60%	33,15%	55,82%	21,41%	24,21%	18,84%
31/12/2004	32,35%	32,96%	22,20%	13,26%	25,55%	13,43%	18,19%	15,68%
31/12/2005	2,08%	0,48%	28,31%	11,91%	34,00%	16,86%	22,99%	14,81%
31/12/2006	37,55%	34,02%	17,80%	7,08%	32,17%	7,54%	-2,85%	0,27%
31/12/2007	7,01%	7,46%	29,57%	19,25%	39,39%	14,86%	22,15%	18,40%
31/12/2008	-48,60%	-5,03%	-45,51%	0,96%	-53,33%	-3,68%	-35,04%	-10,34%
31/12/2009	26,05%	1,11%	56,18%	8,75%	78,51%	9,05%	23,65%	10,28%
31/12/2010	-11,64%	3,62%	20,45%	16,20%	18,88%	11,62%	17,60%	11,70%
22/08/2011	-15,22%	4,93%	-9,63%	3,93%	-14,54%	-0,11%	-0,26%	0,53%

Table VIII – Index vs ES Stable year gross returns: negative year returns are mitigate using a ES Stable model.

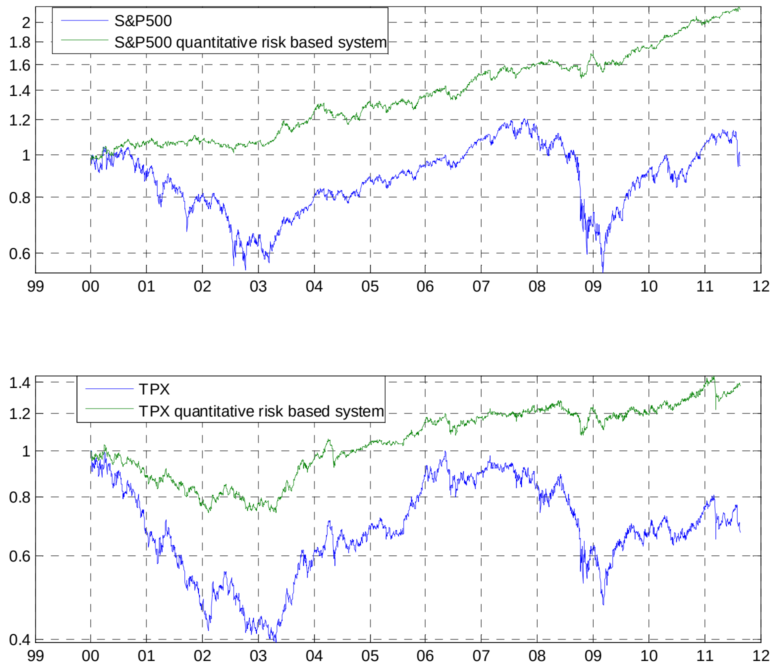


Figure 1: Time Performance of S&P500, Topix B&H and Risk Based System.

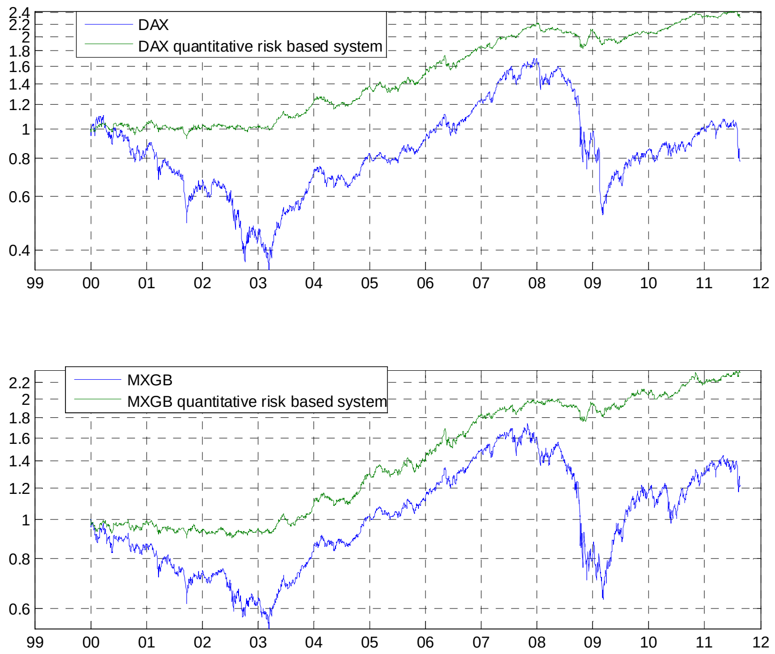


Figure 2: Time Performance of DAX, MSCI Great Britain B&H and Risk Based System.

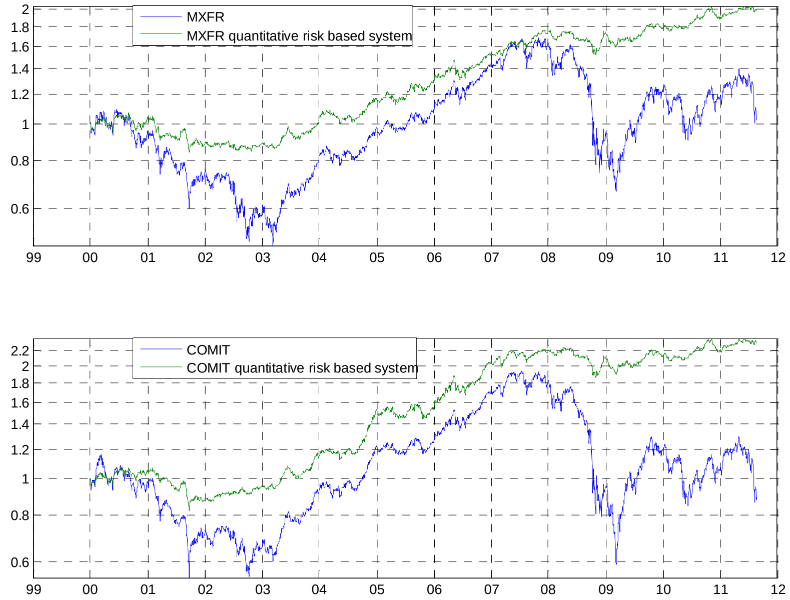


Figure 3: Time Performance of MSCI France, Italy Comit Globale B&H and Risk Based System.

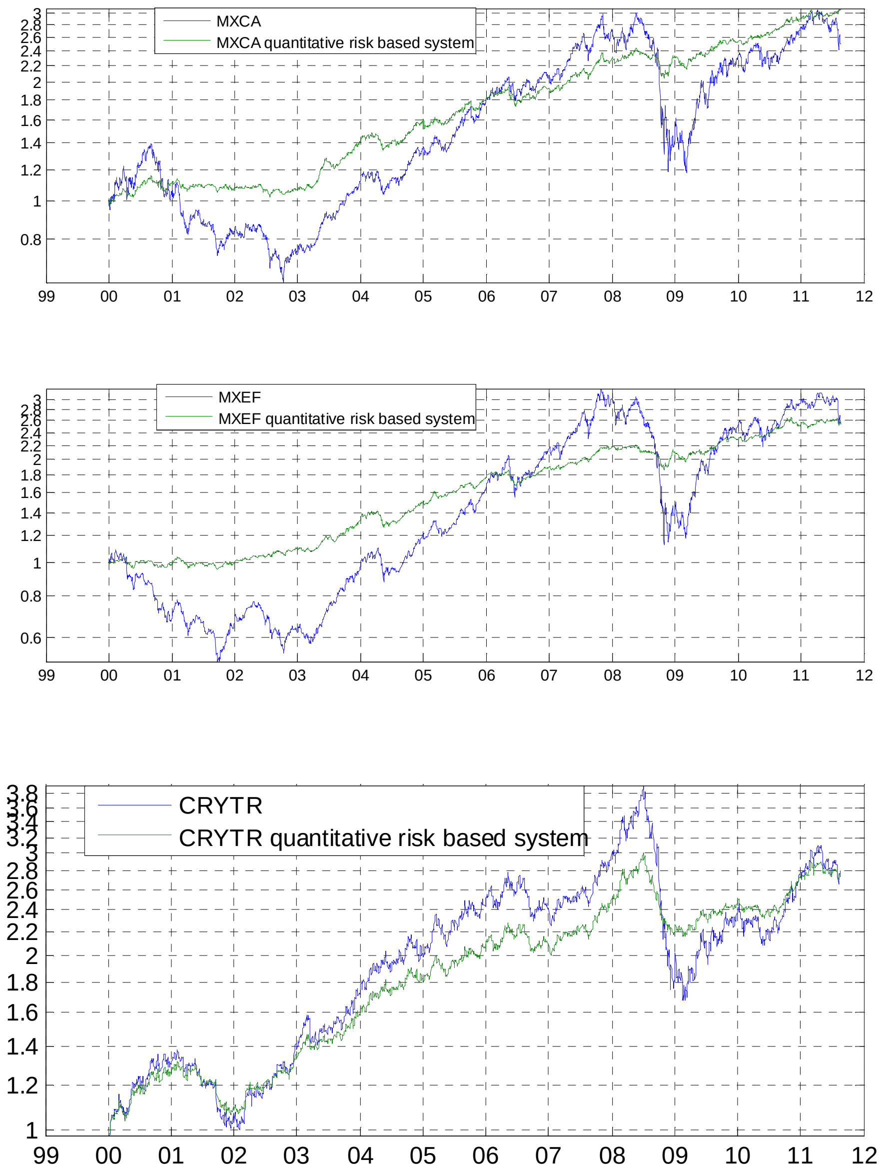


Figure 4: Time Performance of MSCI Canada, MSCI Emerging Markets and RJ/CRB B&H and Risk Based System.

In Table IX we show the single asset class changes in portfolio weights. The growth in GDP in the Emerging Markets generates an increasing weight in MXEF reducing the investment in S&P500.

Asset Class wight from	S&P500	TPX	DAX	MXGB	MXFR	COMIT	MXCA	MXEF	CRYTR	G4A0
31/12/1970	31.9%	6.3%	6.5%	3.9%	4.6%	3.4%	2.7%	10.7%	10%	20%
31/12/1974	29.6%	7.4%	7.2%	3.8%	4.9%	3.4%	2.7%	11.0%	10%	20%
31/12/1979	26.1%	9.2%	7.9%	3.6%	5.7%	3.4%	2.7%	11.4%	10%	20%
31/12/1984	27.1%	9.5%	6.4%	4.0%	4.9%	3.5%	2.6%	12.0%	10%	20%
31/12/1989	26.2%	12.4%	6.1%	3.6%	4.6%	3.8%	2.4%	11.0%	10%	20%
31/12/1994	22.5%	13.6%	6.9%	3.7%	4.6%	4.1%	2.1%	12.5%	10%	20%
31/12/1999	23.4%	12.7%	6.5%	3.7%	4.3%	3.4%	1.8%	14.3%	10%	20%
31/12/2004	26.0%	10.5%	5.3%	4.1%	3.8%	3.2%	1.9%	15.1%	10%	20%
31/12/2009	22.6%	7.7%	5.3%	4.1%	4.1%	3.3%	2.2%	20.7%	10%	20%

Table IX – Asset class weights over time: weight of each equity index in portfolio according the relative weight on global GDP other weights are fixed.

Table X and Figure 5 show gross key risk and performances data for two portfolios: the first one is a portfolio in which we apply a quantitative risk based allocation and the second one is a purely Buy and Hold portfolio. The maximum weight for each asset class is defined in table IX.

In the last ten years our model can protect the investor from quick drawdown and improves risk adjusted returns. Internet Bubble and 2002 recession are skipped and also 2008 financial crisis is taken under control.

In Table XI and Figure 6 we calculate a Total Expense Ratio for the managed portfolio equal to 2% per annum while for B&H portfolio has a 0.6% TER per annum. Risk adjusted measures are reduced a bit, but there are not too many differences with gross data.

Looking at figures on table XIII (net performances on solar year for both portfolio) we have only one negative year (2002: -4.80%) when ES Stable model is used, while with the B&H portfolio there are four negative year and the 2011 performance until August is negative. It is right that we have to give up to a bit of performance in 2003 and 2009, but it seems a reasonable trade off. This model is not a trading model, it may be used in managing pension fund or mutual fund, that have a long time horizon.

Note that our ES Stable may be used also in a portfolio where the risky asset is the B&H portfolio. This way to deal with ES Stable is based on the assumption that there is such co-dependency between assets, so the resulting portfolio may be riskier than the one we present because the risk of the portfolio is more close to the upper bound and the investment in B&H portfolio is much weighted.

However the approach is enough flexible to allow everyone to choose his maximum acceptable level of risk and then follow the more risky or more safety way to construct his portfolio.

In conclusion ES Stable model can protect the invested portfolio when it is necessary, it can be able to cut the left tail and in the meantime being always invested a bit in the risky asset, so to be ready to catch the prices if they start to rise again.

data since 01/01/2000 to 08/22/2011	**Ptf Risk Based System**	**Ptf B&H**
Annualized Return	7.40%	4.60%
Annualized Volatility	5.43%	12.64%
Return Risk	1.36	0.36
MaxDD	-10.31%	-44.48%
Ulcer index	2.43%	14.72%
Min Rolling Annual Return	-6.11%	-40.42%
Max Rolling Annual Return	22.29%	54.05%

Table X – Gross Risk Figure Asset Allocation Portfolio Risk Based and Buy&Hold: in the risk based managed portfolio both risk both performance improves, MaxDD is divided by 4 and ulcer index by 6

data since 01/01/2000 to 08/22/2011	Ptf Risk Based System	Ptf B&H
Annualized Return	5.28%	3.97%
Annualized Volatility	5.43%	12.64%
Return Risk	0.97	0.31
MaxDD	-11.19%	-44.89%
Ulcer index	3.13%	15.30%
Min Rolling Annual Return	-7.94%	-40.77%
Max Rolling Annual Return	19.92%	53.15%

Table XI – Net Risk Figure Asset Allocation Portfolio Risk Based and Buy&Hold in the risk based managed portfolio both risk both performance improves, MaxDD is divided by 4 and ulcer index by 5

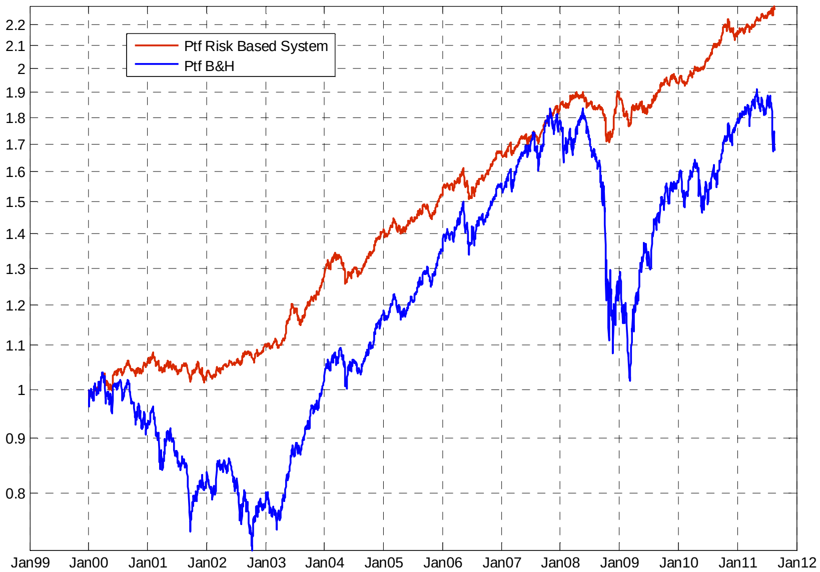


Figure 5 – Gross Performance Asset Allocation Portfolio Risk Based and Buy&Hold

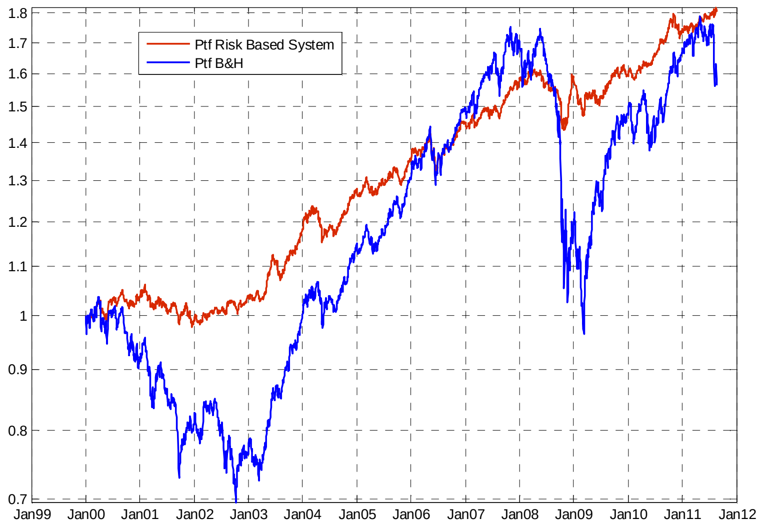


Figure 6 –Net Performance Asset Allocation Portfolio Risk Based and Buy&Hold

Year	ES Stable	B&H
31/12/2000	3,45%	-7,83%
31/12/2001	-4,80%	-12,24%
31/12/2002	4,68%	-5,60%
31/12/2003	13,97%	31,13%
31/12/2004	8,33%	14,94%
31/12/2005	5,40%	13,17%
31/12/2006	7,62%	14,87%
31/12/2007	8,52%	13,88%
31/12/2008	0,43%	-30,14%
31/12/2009	0,68%	26,14%
31/12/2010	9,47%	12,84%
22/08/2011	3,68%	-5,92%

Table XII – Net Solar Year Return Asset Allocation Portfolio Risk Based and Buy&Hold: only 2001 is negative for ES Stable asset allocation portfolio, but it allows to avoid 2008 financial crisis and 2011 euro sovereign crisis

D. CONCLUSIONS

Our purpose was to create a simple-to-follow method for managing risk in a single asset class and, by extension, a portfolio of assets. A non-discretionary risk based model acts as a risk-reduction process with no adverse impact on return.

Our risk model for Expected Shortfall estimation is quick to capture markets movements and thus ensures a good performance in catching fat tails. When tested on various markets, risk-adjusted returns have been almost universally improved. Avoiding massive losses would have resulted in equity-like returns with bond-like volatility and drawdown.

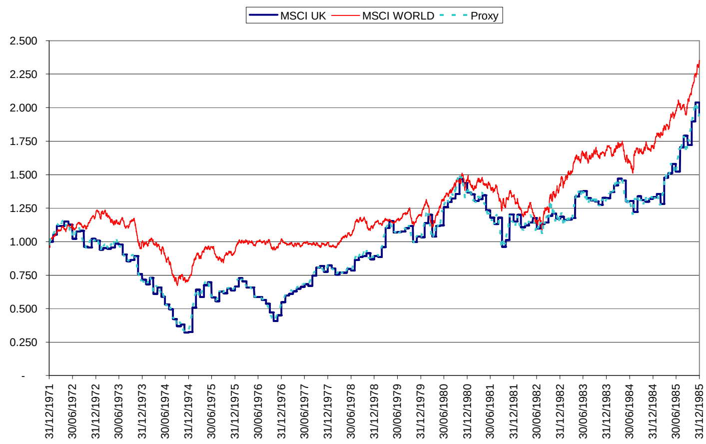
ES Stable model is always investing in risky asset class according the principle that the weight tend to zero as risk increase.

The model do not deal with the optimal asset allocation problem, but is a simple way to deal with asset that anyone would have in his portfolio.

APPENDIX A

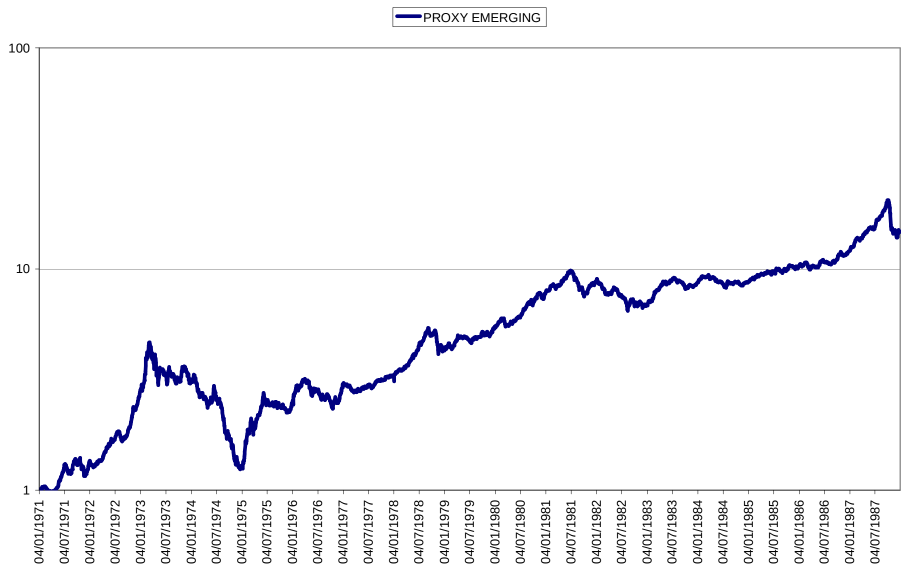
Data sources and Proxy

- Standard & Poors 500 Index (S&P500): source Bloomberg, price return up to 01/03/1988 total return since 01/04/1988;
- Topix Index (TPX): source Bloomberg, price return up to 01/03/1989, total return since 01/04/1989;
- Dax Index (DAX), source Bloomberg, total return since 01/04/1971;
- MSCI United Kingdom Index (MXGB), source Bloomberg, price return up to 12/31/1985, total return since 01/01/1986. Since 1971 to 1985 we have monthly time series, we maintain monthly mean and generate daily return using volatility of MSCI WORLD index (MXWO) source Bloomberg.



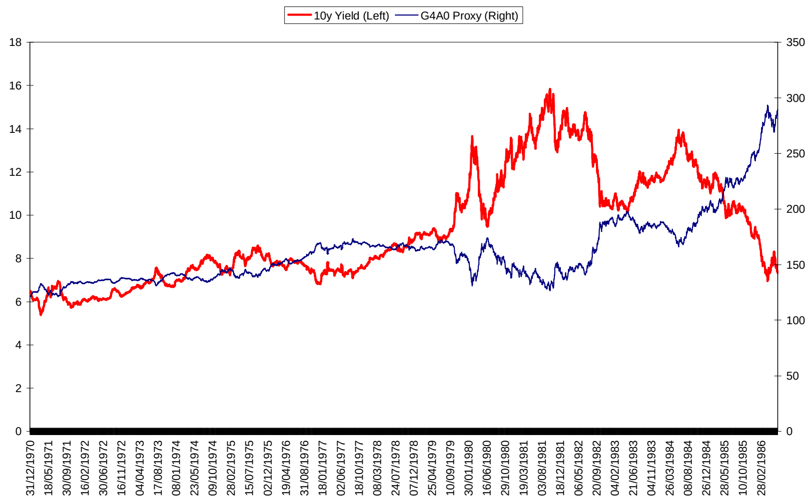
- MSCI France Index (MXFR), source Bloomberg, price return since 07/09/1987 to 12/31/1998, total return since 01/01/1999. Before 07/09/1987 we use MSCI World as proxy;

- Italy Stock Market BCI Comit Globale (COMIT), source Bloomberg, total return since 01/02/1973, before we use MSCI World as proxy;
- MSCI Canada (MXCA), source Bloomberg, price returns up to 12/31/1998, total return since 01/01/1999;
- MSCI Emerging Markets (MXEF), price return since 12/31/1987, total return since 01/01/2001. Up to 1988 we use a proxy (as in figure below) a combination of many indices as Hang Seng (HSI), Sensex index (SENSEX), Taiwan Taiex (TWSE), Thailand Set (SET), Jakarta Composite (JCI), FTSE Bursa Malaysia (FBMKLCI), Brasil Bovespa (IBOV).



- RJ/CRB Total Return Index (CRYTR), total return since 01/03/1994. Before we use S&P GSCI Total Return (SPGSCITR) as proxy;
- Merrill Lynch Unsubordinated U.S. Treasuries/Agencies, 7-10 Yrs (G4A0): source Bloomberg, total return since 11/03/1986. Before we create a synthetic proxy using

10y US yield (USGG10YR) for a 10y bond who pays 6% per annum each six month. Discounting cash flows we get market price. We include coupons to create total return time series.



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