Risk Adjusted Trend Indicator in Asset Allocation

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WAGNER AWARD 2013

Abstract

It is a well known financial principle that diversification reduces risk in portfolio (don't put all your eggs in one basket). Furthermore it is also well known that business cycle is divided in different seasons in which certain assets can be more attractive and some other must be avoided (don't wear the same suit in all seasons). These matters make Asset Allocation the central topic in investment process. Actually lot of studies demonstrate that most of the performances obtained by a portfolio are determined by right or wrong choices took in asset allocation stage.

Analyzing the investment process in more detail it is then possible to see that successful investors don't trust in luck but adopt a clear strategy in allocating their money, which helps them to be objective, leaving subjectivity out of the process. For example, a common problem for many investors is not getting into a position but getting out of it. This fact demonstrates a lack of long-sightedness and create lot of pressure on investor, particularly when open position is losing money.

To create a strategy as objective as possible and to provide evidence of the validity of this active investing approach, this study creates a list of clear mathematical rules which control each step of the asset allocation process.

The idea behind this model is to sort different asset classes and to provide a rank using a single indicator that catches trend and risk. Since it is supposed that the best portfolio contains only assets with the highest momentum and the lowest volatility, composition changes are due to adapt the portfolio to current strengths among markets. To pull down the portfolio volatility the exposition to risky assets is limited. Neither stop loss nor take profit are set

because when security starts to trend at a slower pace or becomes riskier, its rank gets poorer and other asset classes take its place in portfolio. Techniques which are used to control portfolio changes and reallocations are described in the paper, nothing is left to chance.

Beating the market on paper is not that difficult. Applying a certain strategy on a day-to-day basis is a different story. Psychological elements play an important role as well as other aspects such as operative problems that individual investors face in their daily life. Most of them for example can't focus 100% on markets during trading sessions. How much is it helpful a strategy that you can implement in real markets only with expensive, complicated and time consuming operations? The answer to this question suggests the use of practical experience in independent financial advisory with the purpose of solving most of the problems that investors have to face not only in deciding which asset classes have to be bought or sold, but also how and when.

The study wants to be as easy as possible because a key ingredients of a successful investor is a complete understanding and confidence in the methodology which is used. The challenge is to have a strategy that is at the same time enough simple to become clear to individual investors with poor financial education and enough structured to be taken into account by institutional (results show that its implementations can be very interesting also for mutual funds).

The strategy here proposed can be used as a complete portfolio solution or combined with other investment styles as part of a diversified portfolio. Although perfect model do not exist and no strategy protects against losses in short term, adopting a disciplined and systematic approach is the first essential step to be successful in long term.

The efficiency and effectiveness of this study is due to a mix of different techniques which come from technical and quantitative analysis, risk management and money management. Despite the extension of these disciplines, which sometimes limits the number of their followers, the elements proposed in this paper can be understood by everyone.

The study starts with a brief analysis of investor preferences and deals with some basic principles of asset allocation. Then there is an in-depth analysis of the model, the ranking process and the rules that determined a switch between asset classes in portfolio. In order to demonstrate that this methodology can be performed in different market scenarios the study reports back testing results. Moreover there is a proof of the parameters stability used in the model.

This study defends the thesis that active investing and quantitative models can save money from the big disasters of the past decade and substantially outperform a static approach. Dynamism and investor operative troubles (and laziness) are the primary objectives of this study.

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1 Investor Preferences

The aim of providing a disciplined and objective method of allocating money which efficiently merges the simplicity needed by everyday investor life and the complexity necessary to overcome financial challenges, have to start from investor preferences. In order to do this it is important to take into consideration that everything being equal, investors prefer:

- Less movements as possible: rapid and dramatic shifting of weights in portfolio are not appreciated and they are not necessary to beat the market.
- Clear and significant weight of asset in portfolio: holding a little of everything is a strategy that fails to capitalize the big opportunities that markets can create without offering a protection against falls.
- Exclude erratic changes in portfolio: almost all investors are not inclined to sell assets that they have bought few days before, or buy assets that have just been sold. These types of movements generate lack of confidence in methods proposed.

On the other hand it is fundamental remember that:

- Psychology must not enter in investment process: caution, optimism, greed and fear can't influence portfolio performance. Everyone would agree over this issue, actually few people do something to reduce subjectivity.
- Investing needs constant attention: financial markets have to be analyzed with extreme regularity. Someone tends to start to check performance of his investments every day and then reduces time and attention during the next months. Market trends don't respect timetables or sched-

ules, maybe the allocation would be adequate for long periods and then needs frequent and important changes in the next few weeks because market forces change (job, children, football, garden, are not good excuses when bank accounts show losses).

2 Risk Management

The question most people ask, when someone proposes them an investment or a strategy, is related to how much they are likely to gain with it. Successful investors know that expected returns without a correct asses of risk taste like pizza without sauce.

There are different ways through which risk can be managed, the following paragraphs present the simple principles which are used in this study.

2.1 Diversification

The model discussed in this paper takes into account a broad diversification since investments can potentially deal with domestic, international and emerging market equities, bonds, real estates and commodities.

It is important to have such a wide range of choice. Most volatile assets (equities, real estates and commodities) can produce very high returns whether bought and sold at an opportune time. On the other hand, fixed-income and money market instruments can have more stable returns and can provide an effective money refuge when business cycle turns bear.

Diversification itself substantially reduces the unsystematic risk contained in a single security. Be aware not to exceed with the principle of diversification. Indeed, analyzing how risk change according to the number of securities building the portfolio, it is possible to note that volatility sharply decreases at the beginning and then tends to flatten. Moreover global asset allocation reaches a higher level of diversification because it includes asset classes of different nature. Indeed, considering only equity markets it is impossible to get protection from a general market decline because of high correlations among markets. Adding bonds, commodities and liquidity the portfolio is not only free of unsystematic risk (each asset class is the result of a wide range of securities all related to a specific market), but also efficiently fights systematic risk. For these reasons a portfolio with less than ten asset classes can already offer a good level of diversification.

2.2 Risky Asset Limit

Establishing the amount of risk that investor can or want to support is the task of Strategic Asset Allocation, the process which determines the aim of investment according to personal temperament, financial position and stage of life.

Actions that investors put in place to alter weights of assets in portfolio, in order to adapt it to changes in business climate, are instead known as Tactical Asset Allocation. An effective way of doing this, preserving risk inside ranges determined by strategic asset allocation, is limiting the weight that the most risky assets (equities, REITs and commodities) can globally reach in portfolio. Different percentages will return different risk-performance profiles and will

satisfy investors with different risk aversion.

The back tests results reported below refers to a strategy where the limit of buying risky asset has been set to 50% but the model applies also with different percentages.

2.3 Favorable Environment

Another methods that can be used to control risk is related to allocate money in assets only when their conditions are favorable.

Although it is impossible to buy at the bottom and selling at the top, a trend indicator is useful to suggest when conditions are turning from problematic to favorable or vice versa. While this statement is a well known concept for all technicians, the adjustment for risk of a trend indicator is unusual, but can play a fundamental role to rank assets efficiently.

The Risk Adjusted Trend Indicator (R.A.T.I.) proposed in this paper is calculated as:

$$\frac{MA(\text{positive ret}) + MA(\text{negative ret})}{\sqrt{\frac{ATR}{close}}} \quad (1)$$

where

$MA =$ moving average

$ret =$ returns $= \frac{price_{\text{today}}}{price_{\text{yesterday}}} - 1$

$ATR =$ average true range

Numerator is a trend oscillator which expresses the strength of actual market movement. The indicator fluctuates above and below zero. It assumes positive values when positive returns are greater and larger than negative ones. On the other hand, numerator is negative when bear markets grow because negative variations overcome positive returns. This is an intuitive momentum indicator and since it is based on relative numbers (percentage returns) it can be used to compare the trend strength of different assets: markets with an indicator equal to 1 are supposed to be healthier than others with value of 0.5.

However, if the purpose is to make a rank of assets based on a certain indicator, a trend measure is not satisfactory because it doesn't consider risk. Indeed, if we look only at returns, more volatile assets can reach very high value but the risk of drawdown is likewise considerable. For this reason the formula divides the momentum indicator with a volatility measure. With the purpose of using a relative value, the model compares ATR with close price and then calculate the square root to smooth the too wide differences that can exist among assets.

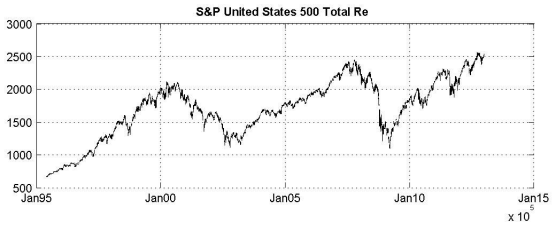
Moving Averages and ATR are calculated with the same length. This is important because there is only one parameter that can affect the model, a positive characteristic for the stability of the strategy that simplifies test and sensitivity analysis. The value attributed to length parameter in this study is 21 (since time is expressed in weeks this means roughly 5 months).

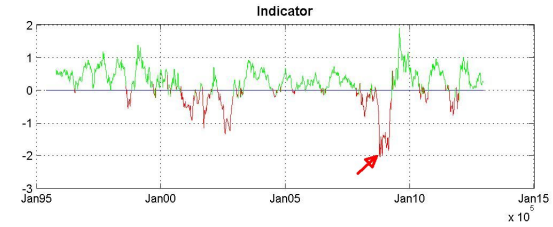
The resulting indicator grows whether momentum increases (that means the trend becomes stronger) and/or risk falls. On the other hand if an asset class turns bear and its volatility climbs, this will comes up with indicator lower values.

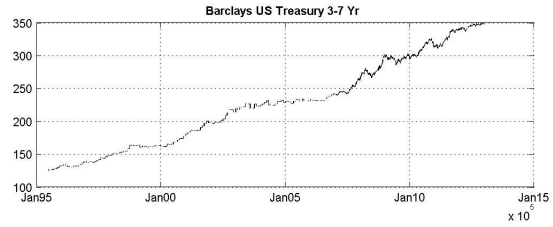
Only asset classes with the most attractive

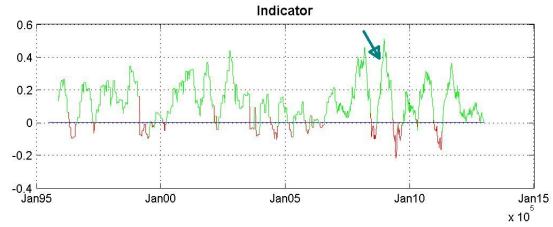
momentum-risk ratio are worth buying.

The following example shows the dynamics of momentum indicator for the "S&P United States 500 Total Re" and the "Barclays US Treasury 3-7 Yr", without considering risk.









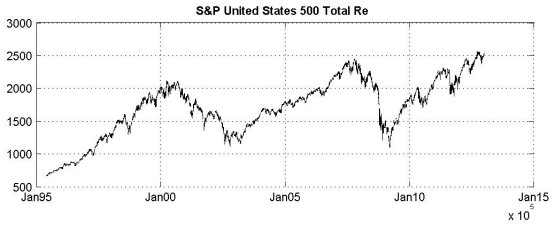
Charts demonstrate that indicator provides useful advises concerning the most favorable periods of each asset. A significant example dates back to October 2008 when the S&P 500 indicator reaches its lowest point. In that date the 3-7 years bonds momentum is positive and gets closer to its historical high.

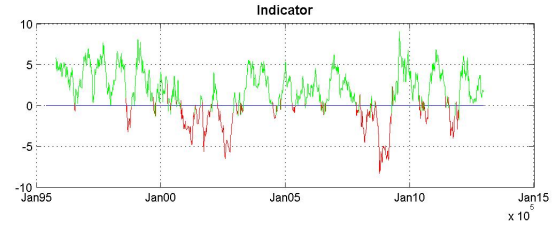
At the same time it's clear that the values attributed to this indicator are not comparable because their refer to objects with completely different characteristics in terms of risk. This concept gets very clearer when looking at the range of values inside which the indicator oscillates. While S&P 500 momentum swings between -2.04 and 1.87, Treasuries indicator varies from -0.22 to 0.51. This means that if each asset at a certain period of time gets a value of 0.3, bonds have to be preferred to equities because their trend has the same strength but bonds are very less riskier and they will have a better contribution to portfolio allocation.

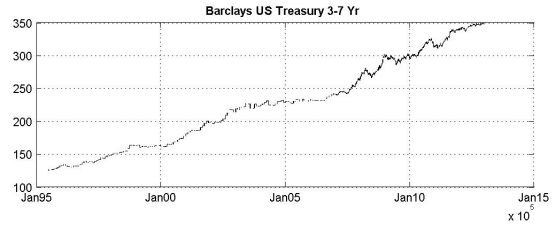
In this example it's easy to take a decision but what about the case in which one asset momentum is 0.1 and the other 0.3?

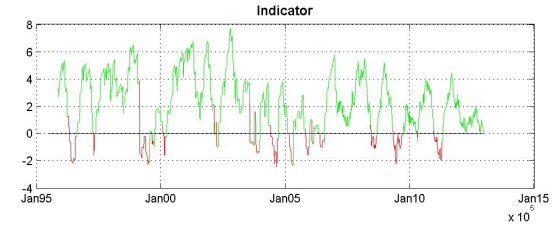
If the indicator provides only a judgment on trend and excludes risk, decisions will be more difficult. When the problem deals with a basket of asset and the answer requested is more complicated than "in or out", the indicator has to be more informative, risks have to be included to provide a homogeneous rank among asset classes.

Risk adjusted trend indicator while maintains the sign of momentum, rescales information considering the volatility of each asset. For this reason the ratio can be used every time to make an assessment of assets and build a right rank of them.









The two graphs above show that the values range of RATI oscillation is very similar also for asset with very different features as S&P 500 and Treasury 3-7 Years. The main consequence of this fact is that in every market context (and not only in extreme ones) it is possible to say which asset has the better risk-reward profile and it is worth putting in portfolio.

3 Basket

The strategy can be implemented using passive (ETFs) or active (mutual funds) vehicles[1] that guaranteed exposure to specific asset classes.

[1]Because of compounding effect it is preferable to use securities which allow the accumulation of interests and dividends accrued.

The basket is a key factor for the model proposed in this paper (as for each bottom-up system), as good quality fuel for an engine. It is fundamental that bonds, equities, commodities and any other assets included in the basket are well balanced with each other. It is important as well that all elements reflect different aspects and charateristics of a certain macro-asset class: equities have to be divided geographically, bonds should be differentiated by issuer and time-to-maturity, commodities should represent different sectors.

This paper use the following basket of ETFs (the choice is justified by their flexibility), but the model can be tested with different asset classes and different securities.

Name	**Ticker**
Spdr S&P 500 ETF Trust	SPY
Vanguard MSCI Emerging Markets	VWO
Ishares MSCI EAFE	EFA
Ishares MSCI Japan	EWJ
Ishares MSCI Pacific Ex Japan	EPP
Ishares Barclays 7-10 Year	IEF
Ishares Barclays 3-7 Year	IEI
Ishares Barclays 1-3 Year	SHY
Ishares Iboxx High Yield	HYG
Ishares Iboxx Inv Grade Corporate	LQD
Ishares Barclays TIPS	TIP
Ishares JP Morgan Emerging Bond	EMB
SPDR Barclays 1-3 Month T-Bill	BIL
SPDR Gold Trust	GLD
United States Oil Fund	USO
IPath DJ-UBS Copper Subindex	JJC
Powershares Agriculture	DBA
SPDR DJ International Real Estate	RWX
Currencyshares Euro Trust	FXE
Currencyshares Japanese Yen	FXY

Other baskets can be created to satisfy investors that can prefer mutual funds or have limits of investment. The basket proposed can be adequate for such persons who don't want or cannot take short position.

The following table reports the benchmark of each etf listed above.

Name	**Ticker**
S&P 500 Total Return	SPTR
MSCI Daily TR Net Emerging Markets	NDUEEGF
MSCI Daily TR Net EAFE	NDDUEAFE
MSCI Daily TR Net Japan	NDDUJN
MSCI Daily TR Net Pacific Free	NDDUPFXJ
Barclays U.S. Treasury: 7-10 Y	LT09TRUU
Barclays U.S. Treasury 3-7 Y	LT13TRUU
Barclays U.S. Treasury: 1-3 Y	LT01TRUU
iBoxx $ Liquid High Yield Index	IBOXHY
iBoxx $ Liquid Investment Grade	IBOXIG
Barclays US Treasury Inflation	LBUTTRUU
JPMorgan Emerging Markets Bond	JPEICORE
Barclays U.S. Tr Bills: 1-3 Months	LD12TRUU
London Gold Market Fixing Ltd	GOLDLNPM
WTI Cushing Crude Oil Spot	USCRWTIC
DJUBS Copper TR	DJUBHGTR
DBIQ Diversified Agriculture ER	DBAGIX
DJW ex US REIT Securities TR Net	DWXRSN
Euro	
Japanese Yen	

As said before the most important thing in building a basket for a bottom-up strategy of investment, is to balance and equilibrate all seeds. At the same time it is fundamental to put in the basket assets less or negatively correlated. This guarantees portfolio diversification and from a model point of view allows the system to take hedge when the scenario worsen for certain elements.

Here below, there is an example that can be explicative and that analyzes return correlations between the S&P 500 and the other indices in the basket.

	S&P 500 TR
MSCI Daily TR Net Emerging Markets	0.725
MSCI Daily TR Net EAFE	0.821
MSCI Daily TR Net Japan	0.466
MSCI Daily TR Net Pacific Free	0.717
Barclays U.S. Treasury: 7-10 Y	-0.401
Barclays U.S. Treasury 3-7 Y	-0.248
Barclays U.S. Treasury: 1-3 Y	-0.318
iBoxx $ Liquid High Yield Index	0.381
iBoxx $ Liquid Investment Grade	-0.091
Barclays US Treasury Inflation	-0.118
JPMorgan Emerging Markets Bond	0.497
Barclays U.S. Tr Bills: 1-3 Months	-0.044
London Gold Market Fixing Ltd	0.013
WTI Cushing Crude Oil Spot	0.243
DJUBS Copper TR	0.449
DBIQ Diversified Agriculture ER	0.257
DJW ex US REIT Securities TR Net	0.712
Euro	0.201
Japanese Yen	-0.313

Unfortunately equity markets, even if geographically diversified are very correlated. An exception to this statement is Japanese equity market that is low affected by other markets and for this reason it is important to include it in the basket, despite its long term negative trend. Government bond are negatively correlated with equity markets, this is true for the long part of the curve (7-10) in particular. This is a good news for the system that has a good resource of returns when equity markets turn bear.

Negative correlated assets are fundamental for a good output of the model but it is important as much

to put in assets with roughly zero correlation with all other markets. This is the case of T-Bill that is decorrelated with all other asset classes (correlation oscillate between -0.1 and 0.1).

4 Strategy

The asset allocation is built with a bottom-up approach that detects each asset class inside the basket and computes the RATI exposed above. The model forgets oversold or overbought levels, forgets divergences, it uses the oscillator with the only purpose of providing a rank which expresses the asset classes that are living a better scenario and where the environment is more favorable.

The idea behind the investment strategy is to put in portfolio only the best asset classes available in terms of trend and risk.

This must be put together with the main purpose of this study that wants to provide an answer to many investors problems highlighted before. For this reason a set of rules have been placed as follow:

- ♢ MHP (minimum holding period) and MOP (minimum outside period): any asset that enters in portfolio can't be sold or switched before one month and any asset that exits the portfolio can't re-enter before one month. This means that any asset can change its weight (even if it is 0%) for 4 weeks. This rule limits performance and adds risk but makes the model very suitable for all type of investor.

- ♢ Assets are equally weighted unless this causes to pass the risky-asset limit (more details will be given later on);

- ♢ Quarterly (13 weeks) weight rebalance: if no signal is provided for a long period of time, as markets fluctuate, some asset classes may outperform or underperform the rest of the portfolio causing them to move away from their original target allocation.

- ♢ Only if an "important difference" between actual portfolio and theoretical portfolio arises the model changes the portfolio composition: even if the indicator proposed is not erratic, the rank can change very often, that would mean in theory that investors have to bring some modification to their portfolio. This is a characteristic that investors and asset managers hate. To quantify what "important difference" means the study changes the portfolio when less than three quarter of the assets in portfolio are confirmed by actual ranking.

- ♢ All items whose indicator doesn't overcome the value of the RATI calculated for T-Bill (or another security representing money market), are not ranked. The weight that would be attributed to these asset classes is allocated in cash, that is the same T-Bill that beats them.

The strategy consists in buying the first seven asset classes according to the realized rank. Since the total weight of "risky assets[2]" (RA) must never exceed 50% (or a different fixed percentage) some rules are set in place:

[2]Risky Assets have been defined as equities, REITs and commodities.

- if

$$\sum_{i=1}^{n} RA_i > 50\% \tag{2}$$

then

$$w_i = \frac{\%\text{ ptf available to risky assets}}{n} \tag{3}$$

because of the MHP rule presented before, the numerator can be smaller than 50%

- the money that is not allocated on "risky assets" because of risky asset limit is put in risk free asset

- the weight of each asset (risky or not) must be higher than that an asset would have in equally weighted system with the double of seeds

$$w_i > \frac{1}{2 * \text{num of asset}} \tag{4}$$

Because of these rules, even if the initial aim was to focus on the first seven asset classes, under certain conditions, the portfolio can get more than seven elements.

5 Back Test

The study analyzes the behavior of the strategy using 10 years of weekly data, from 28-Jun-2002 to 28-Jun-2012.

There are three elements that affect the accuracy of the results reported below:

- Trading costs are not included because they can differ from one investor to another in very significant ways. To remedy to this imprecision, back tests provide a measure of portfolio turnover, so that anyone can evaluate the impact of trading cost on performances.

- Taxation is not considered because it depends on many elements including investor, instruments used, structure of portfolio, etcetera.

- Tests are conducted using ETF's benchmarks and not ETFs themselves. This choice has been done for simplicity, particularly in relation to bond etf, many of which distributed dividends. Total return indices include any returns that investor would have from that security. On the other hand the back tests doesn't consider the tracking error that divides ETF from its benchmark.

To minimize the gap between back tests results, that are based on 10,000,000 virtual dollars invested in the proposed strategy, and those which would be realized with real money in the past 10 years if an investors would have adopted this system, some tricks are used:

- Since the model uses weekly data and since in some cases quotes of the previous week of indices and benchmarks are not available until Monday night, the program simulates the buy and sell operations using Tuesday prices, when signals are certain and investors would operate obtaining similar prices.

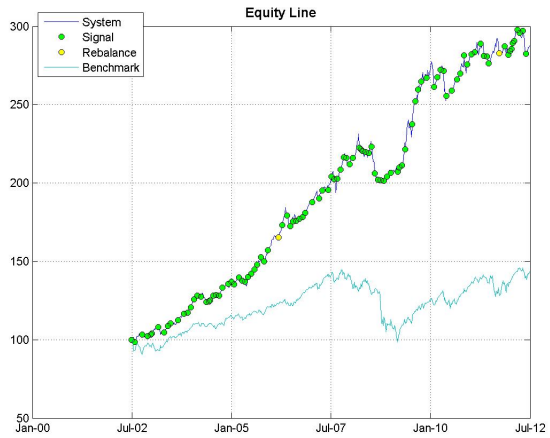
- When investors pass orders to their brokers they don't know at which prices this would be done. This means that they ask to buy 100 pieces of

a certain security but they don't know exactly which is the total amount that they would invest. This means that in simulation it is not possible to compute quantity based on 100% of portfolio nav, because it would be possible that there was not sufficient money to invest. To account for this fact the program calculates the quantities that must be bought using 98% of previous week nav. Consequently, roughly 2% of nav is always allocated in cash.

- When some signal occurs also the asset classes that would not be involved by the switches are rebalanced. This is not an unreal condition if transition costs are low and the total amount invested is high.

The following graph shows the equity line progress in the 10 years analyzed, in comparison with a benchmark that is 50% S&P 500 + 50% T-Bill. Although an active investment strategy usually presents a money benchmark, this index helps to appreciate the validity of the strategy in different market situations. Moreover, this benchmark has an historical volatility that is similar to the strategy and finally it is easy to reproduce through the purchase of two ETFs.

Each green dot is a signal that can represent multiple purchases and multiple sales (on average each signal consists in a couple of switch between different asset classes). Yellow dots appear after 3 months of absence of signal and so they suggest a rebalance of weight.



At this stage some numbers are due:

	AA System	Benchmark
Annualized Performance	11.14%	3.68%
Annualized Volatility	7.96%	9.74%
Max Draw Down	13.09%	31.77%
Max Loss in 6 months	12.76%	24.3%
Ulcer Index	3.916	9.371
Performance/Volatility	1.399	0.378
Performance/Max DD	0.851	0.116
Performance/Ulcer Index	2.844	0.393
Max Time in DD (months)	14.5	53.2
Critical Months	23.14%	
Max Consecutive Critical M	3	
Average Turnover	3.7	
Average Num Signals for Year	10.7	

The first line is surely the most impressive one. Even if the performance must be reduced to account for trading costs and fiscal impact, the difference between the strategy and the benchmark is very large. This gap seems widely justify the use of this active investment model and it suggests that it is worth to spend some time to implement a dynamic asset allocation strategy instead of a static one.

In the following table, the detail of how and when this gap was accumulated is shown. It is possible

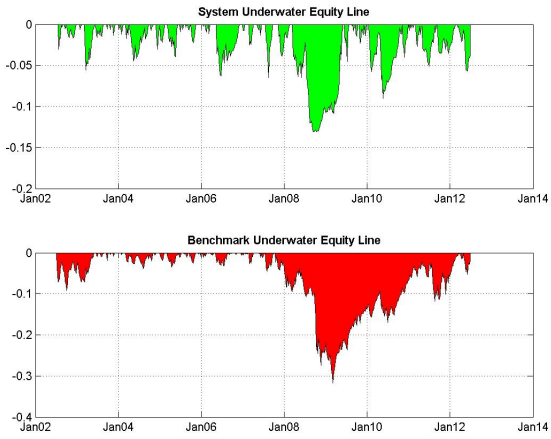
to see that the last three years are the most difficult for the strategy. Indeed, the absence of a clear economic scenario added to the short life of trends in all markets, although produces a positive performance for the model, it doesn't allow to overcome the benchmark. In all other years that has been analyzed the difference is very impressive. The value of the strategy can be particularly appreciated in 2008 and 2009, when the model was able to cut losses when the financial world crashed and then started a long climb when markets rebounded (a similar story seems to characterize the biennium 2002-2003). The most important fact to point out is that these results have been generated thanks to the same rules and the same algorithms that have demonstrated their effectiveness and efficiency in all periods.

	AA System	Benchmark
2002*	4.1%	-4.97%
2003	15.93%	13.44%
2004	13.54%	7.2%
2005	16.95%	4.06%
2006	18.02%	10.94%
2007	12.79%	5.61%
2008	-2.6%	-22.46%
2009	31.23%	14.22%
2010	3.43%	7.95%
2011	0.8%	1.21%
2012*	1.2%	5.36%

* six month performance

As mentioned before the asset allocation system volatility is very similar to that of benchmark. In relation to this point, it is important to underline that the model volatility can change a lot from period to period. Eight percent is an average measure, but when the portfolio has the 50% of asset allocated in equity, its volatility can be higher than in the periods of time when the environment is adverse and the portfolio is 100% invested in bonds. In this context it is possible to understand the reason why the model put all money that would not invest in risky asset (because of the limit of 50%) in cash or money markets security. Indeed this choice allows to lower the volatility in bull markets and to smooth the volatility of different economic scenarios.

A fundamental measure of risk to evaluate a strategy is the maximum draw down. The table above also reports the maximum level of a rolling draw down calculated with a 6 months window (Max Loss in 6 months).

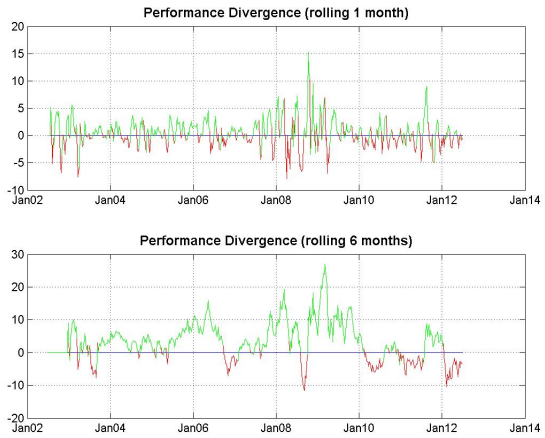


The strategy maximum draw down realized in correspondence of the 2008 financial crisis is 2 and half times smaller than that of the benchmark and in the graph above it is possible to show that while the strategy bottoms and starts to recovery, the benchmark keeps on falling. An immediate consequence of this fact is that the maximum time in draw down, the time that passes before new highs are touched, is infinitely lower than the benchmark, which layes

below the value registered in 2007 for more than 4 years.

In the long run, the strategy demonstrates its effectiveness but in short term it can cause some trouble. Indeed, there can be months in which things don't go as they should and the model underperforms the benchmark. In order to account for the psychological cost the paper reports the percentage of "Critical Months", that is the months in which the strategy performs negatively and the benchmark returns to a better performance (even if negative). If the strategy underperforms the benchmark but it gives back a positive growth, it is not considered a "Critical" situation. The percentage shown in the table above is not very comforting because it says that more than the 20% of months are "Critical". Moreover, the table says that there can be up to 3 consecutive months of stressed performance. These data can coexist with a low time in draw down only whether the system widely overcomes the benchmark in "no Critical" months. This means that it is not advisable to implement the strategy for a short period of time, the model needs some years to demonstrate the consistency of its structure.

With the same purpose of measuring the stress impact of an active strategy when things go wrong in the short term, the following chart reports the difference between the performances realized in 1 month or in 6 months by the strategy and by the benchmark.



It is very interesting to note that in both charts there seems to be a sort of technical support for the indicator plotted. Indeed every times that the difference of 1 month performance reaches -6.5% the system reacts and recovers against the benchmark. In the same way, there are only 2 cases in which the underperformance of 6 months is larger than 10 percent. These are not little losses but they are very useful levels to evaluate the model behavior when it is very difficult to continue to follow its signals because the benchmark consistently overperforms the strategy.

Putting all these considerations together, the time horizon suggested for the strategy is the medium term (3-5 years).

The last two rows of the results table describe the characteristics of the model in terms of operativeness. The strategy proposed is dedicated to those investors that want to invest their money actively but they can't or don't want to change the portfolio allocation very often, that can coincide with the purpose of finding the right equilibrium between the advantages of an active strategy and its costs. In this sense the

two numbers say that the model reaches these aims. Indeed, on average there is less than one signal for month. This result can be justified only in part by limitations imposed in the model to the operativeness such as the MHP or the MOP. Low trading with high performance is not a very common combination in investment strategies but it is very appreciated by all investors. The average turnover indicates that the portfolio has completely changed 3.7 times every year. This can help investors to evaluate the trading costs that they will hold, according to the agreement taken with their brokers, if they intend to adopt this investment model.

6 Asset Allocation Evolution

The portfolio composition can change very much over time even with small but systematic movements. This flexibility and dynamism are the strength of the model and in order to demonstrate the effectiveness of the strategy in this sense, it is possible to see, in the following rows, some snapshot of the model portfolio at different periods of time.

15-Aug-2003: after a big crisis it's very difficult to take risks because recent wide losses are too clear in investors' mind. The model can be an important psychological tool to insert risk in the portfolio and to select the right asset classes that can effectively react to positive impulses.

Asset	**Weight**
S&P 500	7.1%
MSCI Emerging Markets	7.1%
MSCI EAFE	7.1%
MSCI Pacific	14.3%
REITs	14.3%
iBoxx $ Liquid High Yield Index	14.3%
JPMorgan Emerging Markets Bond	14.3%
Barclays U.S. Tr Bills: 1-3 Months	21.4%
	100%

10-Mar-2006: while the expansion process took place the portfolio must add diversification to benefit from a grow in all asset classes.

Asset	**Weight**
MSCI Japan	7.1%
MSCI Emerging Markets	7.1%
MSCI EAFE	7.1%
MSCI Pacific	7.1%
REITs	7.1%
Gold	7.1%
Copper	7.1%
Barclays U.S. Tr Bills: 1-3 Months	50%
	100%

9-Sep-2008: this is the Tuesday before Lehman Brothers default (Monday 15-Sep-2008), all elements were in places which suggest it's no time to take any type of risk. In such cases Treasury Bills are the best solution to continue to slip the night.

Asset	**Weight**
Barclays U.S. Tr Bills: 1-3 Months	100%
	100%

02-Jul-2009: after a quick rebound equity markets were ready to continue their run. Also the main commodities climbed on expectation of a recovery of the economy.

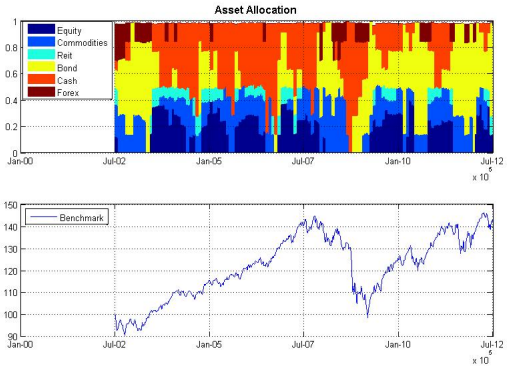
Asset	Weight
MSCI Emerging Markets	10%
MSCI Pacific	10%
Crude Oil	10%
Gold	10%
Copper	10%
JPMorgan Emerging Markets Bond	14.3%
iBoxx $ Liquid High Yield Index	14.3%
Barclays U.S. Tr Bills: 1-3 Months	21.4%
	100%

02-Sep-2011: volatility and uncertainty characterize the markets. With the ECB that fights the debt crisis in Europe and the Fed involved in a super accommodating monetary policy in USA, bonds are the asset class preferred by investors.

Asset	Weight
Barclays US Treasury 7-10 Y	14.3%
Barclays US Treasury 3-7 Y	14.3%
iBoxx $ Liquid Investment Grade	14.3%
Barclays US Treasury Inflation	14.3%
JPMorgan Emerging Markets Bond	14.3%
Gold	14.3%
Crude Oil	14.3%
	100%

As these example shows, the model doesn't fear the T-Bill investment to save money and reduce volatility. Results could improve if a different way of managing excess liquidity would be proposed but this is not the topic of this study.

The following chart summarizes all these considerations showing the evolution of asset allocation. To better understand how the model responds to market stimulus the graph of the benchmark has been plotted below. It is possible to see that the sum of equities, commodities and REITs never overtakes the 50% addresses in the first stages. As just said, the percentage of cash securities can be high for long period of time, to counterbalance risks took investing in "risky" markets.



By analyzing colors in the chart and their alternation, it is possible to foresee the turnover of markets and sectors, that is the evolution of the economy cycles over time, as represented by the benchmark.

7 Sensitivity Analysis

For technical indicators, there is a trade-off between sensitivity and consistency. In an ideal world, an indicator is sensitive to price movements so that it gives signals in advance and at the same time provides few false information. Unfortunately this never happens. Indeed, by reducing the number of periods analyzed by the indicator, the algorithm would provide early signals but the number of false ones would increase. Vice versa if the indicator is less reactive (the length used is higher), then false signals will decrease, but the signals will lag and this will reduce performance.

Because of this trade-off, it is important to conduct sensitivity analysis tests of all strategies which use technical indicators. In particular, it is important to

analyze how results alter when parameters change.

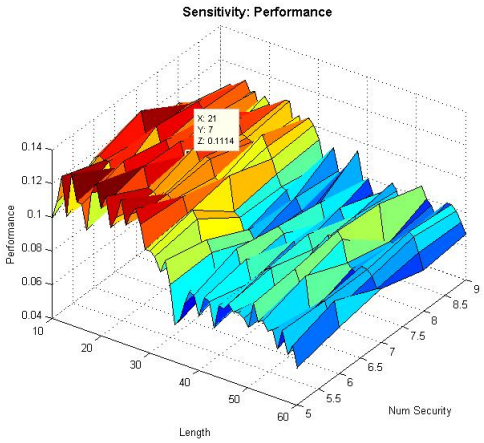
The over-parameterization of some model provides its self excellent results, but there is no way of distinguishing between the goodness of the indicator (or the effectiveness of the strategy) and the chance generated by the huge amount of parameters. This is not the case because, as said in the first part of this work, things would be set as easy as possible.

The Risk-Adjusted-Trend-Indicator, implemented in the strategy to provide a rank of asset classes, uses just one parameter that is the length of the period analyzed to compute momentum and volatility. In the analysis of sensitivity reported here the length parameter has been ranged between 10 and 60.

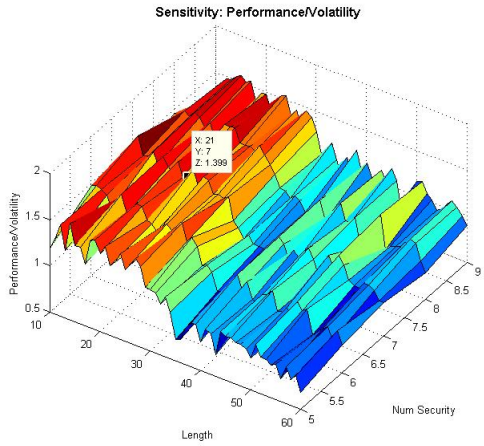
It can be interesting to show if there is a consistent change in performance and riskiness of the strategy if the number of securities extracted from the rank changes (the back tests refer to 7 asset classes). For this reason this variable has been detected in parallel with the RATI length. In this case the values between 5 and 9 have been analyzed.

Using a tridimensional graph it is possible to show three variable at time: the two parameters mentioned above and the results that they produce once inserted in the model.

The following graph shows changes in performance related to alteration of parameters.



Since it is important not to detect only results of the strategy in terms of performance but also in terms of riskiness, the next chart shows how the performance on volatility ratio changes when parameters are different.



The combination of parameters that have been used to generate the results discussed above in the section dedicated to back test, is 21-7 (the first is the length used to compute the indicator and the second is the number of securities extracted from the rank). The pictures above say that there is a good stability of results around the couple of selected values. Results starts to worsen for value of the length greater than 26, while there is a good efficiency of the model relative to the number of securities in

portfolio.

The simplicity of the model, that is reflected in a very low number of parameters used, allows to conduct an effective and significant sensitivity analysis. With more than two parameters it is impossible to use the support of a tridimensional analysis shown here. This is an immediate and easy to read instrument which simplifies the conduction and the interpretation of results and speed up the valuation of the strategy stability. The essential message that these charts seem to communicate is that the strategy proposed produces stable results around the values selected.

8 Conclusions

The aim of this study is to provide evidence of an effective asset allocation strategy based on a risk-adjusted-trend-indicator. The model purpose is to join together the main academic principles concerning portfolio allocation with investors needs and preferences observed in real world in independent financial advisory practice. To reach these objects it is important to build a systematic and mechanical approach to investment that can be followed by all type of investors even if they don't have a good financial knowledge or they don't have many time to dedicate to their investments.

Investing is not a matter of greed but it is, first of all, question of patience and discipline.

The strategy starts with simple and basic principles that rules asset allocation, like diversification and risk control, and adapts these concepts to provide a model portfolio that, from an operative point of view, satisfies investor preferences.

The risk-adjusted-trend-indicator (RATI) is used to identify the best asset classes that it is worth to put in a portfolio. To pick out the healthiness of each security the RATI ranks the different asset classes taken into account.

Since it is a bottom-up strategy, the composition of the analyzed basket is not only relevant but fundamental for the efficiency of the model. The example here proposed refers to an ETFs basket that has been built to be well balanced, diversified and it includes roughly all main asset classes.

The active strategy proposed produces superior performance in comparison with a passive benchmark but the difference between the two is much more appreciable from a risk point of view. Indeed, even with a similar level of volatility in the ten years analyzed, the active strategy implemented destroys draw down and improves all other risk indicators.

This doesn't mean that the strategy is suitable for every investors at all times. This is because the strategy has an absolute return or a total return philosophy which produces a complete decorrelation with a market benchmark. The correlation ratio between the equity line shown in the back tests section of this paper and its benchmark (50% T-Bill and 50% S&P500) is equivalent to 0.221. The strategy can live good seasons and bad seasons. In general, back tests demonstrate a good efficiency of the strategy to perform well and to adapt to different economic scenarios.

Sensitivity analysis shows that results are not ran-

dom generated, but are made choosing an accurate combination of parameters that produce superlative returns. The presence of two parameters helps the realization of this analysis and the demonstration of a good stability of the model.

The simplicity of the strategy joint with its attention to operative and real matters are the keys of its effectiveness and the reason why its implementation with real money can be very easy.

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