BNP PARIBAS INVESTMENT PARTNERS | The asset manager for a changing world

Smoothing your ride: how managing risk can lead to higher returns

OVERVIEW

Targeting a constant risk budget over time improves the risk-return trade off in a number of key asset classes, asserts a new study by BNP Paribas Investment Partners. In this paper, members of our Financial Engineering Team detail how to employ an inter-temporal risk parity strategy to rebalance between a risky asset and cash, and thereby target a constant level of risk over time. The weight of the risky asset in the portfolio is always positive and, if necessary, one may leverage it. The weight of the risk free asset (cash) can be positive or negative, depending on whether one leverages the risky asset to attain the constant risk target.

Click here to read the full white paper

IMPROVING SHARPE RATIOS AND REDUCING DRAWDOWNS

Inter-temporal risk parity, sometimes referred to as constant volatility or inverse volatility weighting, is a strategy which rebalances between a risky asset and cash in such as to keep the risk constant over time. If financial assets behaved as it is described in most financial textbooks, i.e. returns followed Gaussian distributions, the strategy would be of no interest. But empirical evidence tells us otherwise.

“An inter-temporal risk strategy, when applied to equities (and compared to a buy and hold strategy) is known to improve the Sharpe ratio and reduce drawdowns,” according to Romain Perchet, BNP Paribas Investment Partners Quantitative Analyst and a co-author of the study. “We used Monte Carlo simulations based on a number of time series parametric models from the GARCH[1] family, in order to analyze the relative importance of a number of effects in explaining those benefits. We found that volatility clustering with constant returns and the ‘fat tails’ are the two effects with the greatest explanatory power. The results are even stronger if there is a negative relationship between return and volatility,” Mr. Perchet continued.

Our white paper on the advantages of an inter-temporal risk-parity strategy was written by Romain Perchet, Raul Leote de Carvalho, Thomas Heckel and Pierre Moulin, all of our Financial Engineering Team. If you would like to know more, please contact your local sales teams. The paper in its entirety may be downloaded at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2384583

"Using historical data, we also simulated what would have been the performance of this strategy when applied to equities, corporate bonds, government bonds and commodities. We found that the benefits of this strategy are more important for emerging equities and high yield bonds, which show the strongest volatility clustering and fat tails. The effects are also important for developed equities, but less so than for commodities. For investment grade corporate bonds and government bonds, volatility clustering has not been sufficiently strong in the last 20 years to generate any significant or visible effects, according to the authors of this study," noted Raul Leote de Carvalho, BNP Paribas Investment Partners Head of Quantitative Research and Investment Solutions and a co- author of this study.

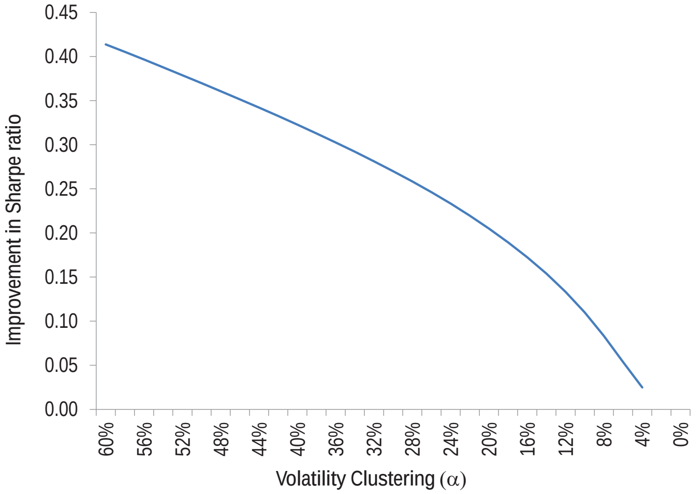
MONTE CARLO SIMULATIONS, GARCH MODELS KEY

"Our Monte Carlo simulations, based on scenarios generated from GARCH models, allow us to confirm these effects and to analyze in detail the dependence of the benefits of inter-temporal risk parity strategies on the parameters of the models," said Mr. Perchet. "The volatility clustering effect is, in essence, a market timing effect. If the volatility changes and returns remain constant, then the Sharpe ratio is higher in lower volatility regimes, and increasing the weight of the risky asset in such periods will result in better risk-adjusted performances," added Mr. Perchet.

"When fat tails are present in the distribution of the returns of the risky asset (reducing the exposure to the risky asset in regimes of higher volatility) in addition to volatility clustering, the result is not only a larger improvement in the Sharpe ratio, but also smaller drawdowns than when following a buy and hold strategy," Mr. Carvalho observed. "The effects are more pronounced if, additionally, the distribution of risky asset returns shows a smaller mean return in regimes of higher volatility and larger mean returns in regimes of lower volatility. In particular, this tends to be the case for equities and for high yield bonds," he added.

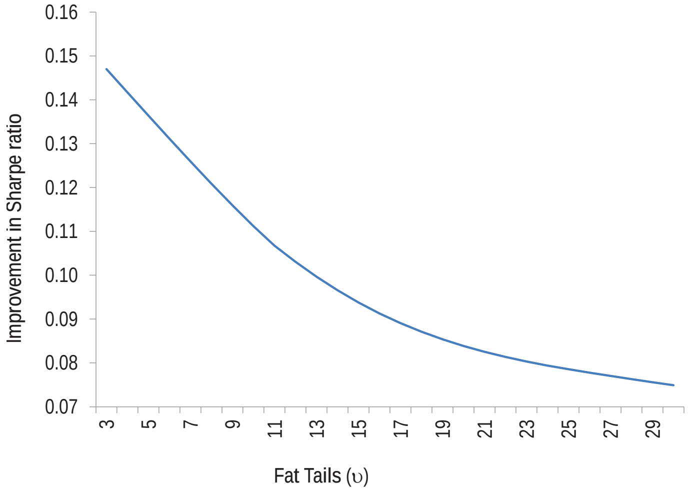
Improvement of Sharpe ratio according to clustering effects and fat tail effects

Chart 1: Clustering Effect on Sharpe Ratio



Clustering effect changes from 60% (high effect) to 2% (small effect)[2]
Source: BNP Paribas Investment Partners, January 2014

Chart 2: Impact of Fat Tails on Sharpe Ratio



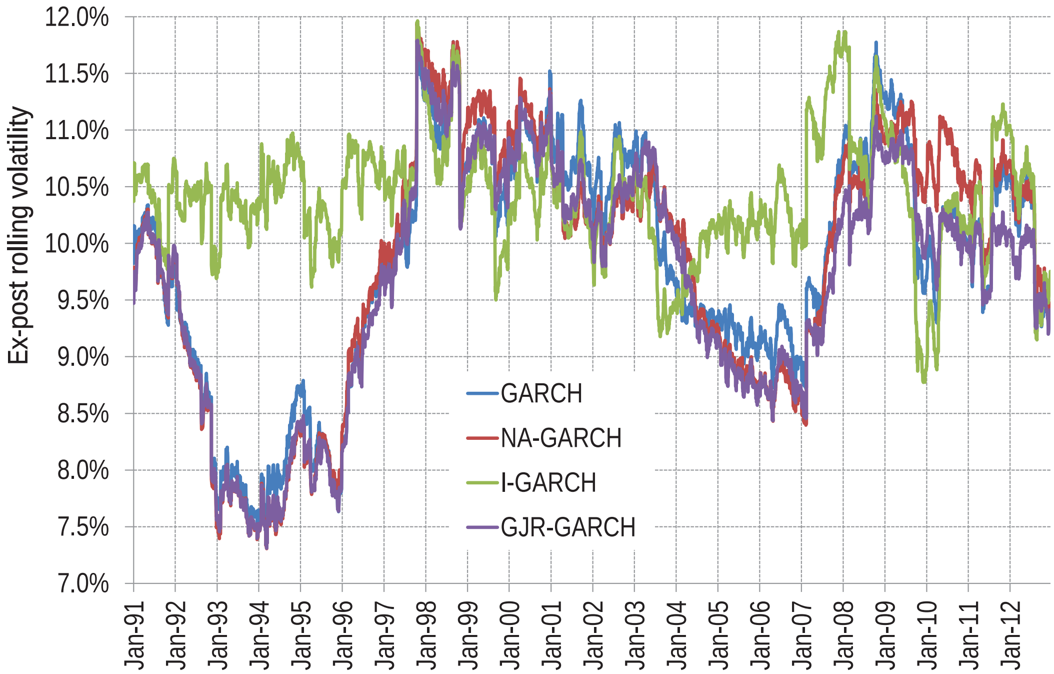
Frequency of fat tail events changes from 3 (frequent fat tail events) to 30 (low frequency of fat tail events).[2] Source: BNP Paribas Investment Partners, January 2014

CONSIDERATIONS FOR THE PRACTICAL APPLICATION OF THE STUDY

Mr. Perchet stressed, "The inter-temporal strategy is robust to changing the frequency of rebalancing of the portfolio, and the benefits are found irrespectively of whether investors perform daily or weekly rebalancing, the study found. Reducing the frequency any further erodes some of the benefits and increases ex-post volatility. Levels of acceptable turnover for a practical implementation can be found with weekly rebalancing, results suggest. Further reduction of turnover can be achieved with daily monitoring of volatility and rebalancing only when the volatility changes significantly.

"We recommend the use of I-GARCH models for the practical implementation of this strategy," Mr. Carvalho said. "This shows the strongest predictive power and manages to keep ex-post volatility rather close to target. The improvement of the Sharpe ratio and reduction of drawdowns, when compared to buy and hold strategies, was superior than that found using other GARCH models."

I-GARCH most efficient model to target volatility over time



Comparison of the one-year rolling ex-post volatility of an inter-temporal risk parity strategy applied to the S&P 500. The target volatility is 10% and the forecast volatility is based on four different GARCH models, with parameters estimated from an expanding window once every year at the start of each year. Source: Bloomberg, BNP Paribas Investment Partners, January 2014

WRAPPING IT UP

Mr. Perchet and Mr. Carvalho concluded, "This study, just released as a new research paper, highlights the importance of risk management in asset allocation portfolios. The fact that volatility is not constant over time and tends to exhibit volatility clustering, thereby making it easier to forecast, is of great importance. Investors should think in terms of risk budget allocation rather than fixed weights. Inter-temporal risk parity strategies dynamically adapt the asset class weights to target a desired risk budget quite successfully, and can show better risk-adjusted returns. Moreover, since risky asset classes also show fat tails, inter-temporal risk parity strategies can smooth their impact and reduce drawdowns relative to buy-and-hold strategies that rebalance. The fact that, in some asset classes, returns are on average lower in periods of higher volatility brings additional benefits, further improving the Sharpe ratio for those asset classes when targeting a constant risk. For less risky asset classes such as government bonds, the strategy shows little added value other than keeping the risk budget constant."

Talking about applications of the study, Mr. Carvalho argued that "our study has important consequences for investors and is strongly supportive of risk overlays, i.e. the application of overlay strategies which aim at controlling for risk and reducing drawdowns in asset allocation portfolios. It is also strongly supportive of defining strategic asset allocation portfolios in terms of risk budget allocations rather than static weight allocations, which is the common practice."

A BRIEF SUMMARY OF THE STUDY

The authors discuss several topics in this new study, including a detailed quantitative review of the inter-temporal risk parity strategy, Monte Carlo simulations of the strategy returns using GARCH models, simulations of what would have been the performance of inter-temporal risk parity strategies applied to different asset classes that serve as guides to the practical application of this strategy in large-scale investment management. Included are 15 Exhibits (see example below) depicting the side-by-side comparisons of various buy and hold strategy returns with those projected by the inter-temporal risk strategy, under widely varying investment conditions.

Comparison of Buy and Hold Strategy versus Intertemporal Risk Parity Strategy

	Russell 1000	MSCI Emerging Markets	S&P GSCI Commodity	US High Yield Bonds	US Investment Grade Bonds	US 10Y Government Bonds
	Buy and hold strategy					
Average annualized excess return	8.0%	6.7%	2.3%	4.8%	3.7%	3.2%
Average annualized volatility	19.0%	19.2%	21.6%	4.4%	5.1%	8.0%
Sharpe ratio	0.42	0.35	0.11	1.09	0.73	0.40
Maximum drawdown (MDD)	-55.8%	-65.2%	-73.4%	-29.1%	-16.7%	-14.1%
Ratio MDD / volatility	-2.9	-3.4	-3.4	-6.6	-3.3	-1.8
Average exposure	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
I-GARCH	Inter-temporal risk parity strategy					
Average annualized excess return	2.9%	3.0%	0.8%	8.5%	3.9%	2.1%
Average annualized volatility	5.2%	5.4%	5.2%	5.5%	5.1%	5.2%
Sharpe ratio	0.56	0.56	0.15	1.55	0.76	0.40
Maximum drawdown (MDD)	-10.4%	-19.1%	-16.7%	-28.5%	-11.2%	-10.2%
Ratio MDD / volatility	-2.0	-3.5	-3.2	-5.2	-2.2	-2.0
Average exposure	36.8%	36.5%	28.9%	181.3%	108.9%	70.0%
Turnover	1.3	3.8	2.5	9.2	3.7	2.4
Improvement in Sharpe ratio	0.14	0.21	0.05	0.45	0.04	0.00
Student test	0.66	0.98	0.24	2.12	0.15	0.07

Assume target volatility at 5% and using forecast volatility from I-GARCH models. The GARCH model parameters are estimated from an expanding window once every year at the start of each year. Source: Bloomberg, BNP Paribas Investment Partners, January 2014

BACKGROUND OF THE AUTHORS

Raul Leote de Carvalho, PhD
Head of Quantitative Research and Investment Solutions
Financial Engineering

Raul Leote de Carvalho has over 14 years of experience in Finance and is the Head of Quantitative Research and Investment Solutions in the Financial and Engineering team of BNP Paribas Asset Management in Paris since 2007. He is responsible for carrying out innovative quantitative research applicable in the development of quantitative strategies for different investment teams in either equities, fixed income or asset allocation and also for the use of advanced quantitative approaches in the design of investment clients solutions.

Prior to that, from 2003 to 2007 he held the position of Senior Quantitative Strategist in the Global Strategy team of BNP Paribas Investment Partners located in Paris where he participated in the regular Asset Allocation Committees and developed a number of quantitative models for asset allocation. He joined Paribas Asset Management in 1999 in London as a Quantitative Analyst, a position he held until 2002, working mainly on the application of robust portfolio optimisation techniques to portfolio construction, the development of FX and fixed income models and also as fund manager of asset allocation portfolios.

Before he spent 3 years working as a Research Associate in Computational and Theoretical Physics at the University College of London, at the Ecole Normale Superieure de Lyon and at the University of Wuppertal. He obtained a PhD in Theoretical Physics from the University of Bristol in 1996, an MSc in Condensed Matter Physics in 1992 and a BSc in Chemistry in 1990 both from the University of Lisbon.

He is a member of Inquire Europe and the author of a many refereed papers in Finance and Physics published in several academic journals.

He passed the Investment Management Certificate in London in 2001.

Romain Perchet
Quantitative Analyst
Financial Engineering

Romain Perchet has 6 years of experience in Finance and has joined the Financial and Engineering team of BNP Paribas Asset Management in Paris since 2008. He works for carrying out innovative quantitative research applicable in the development of quantitative strategies for asset allocation and also for the use of advanced quantitative approaches in the design of investment clients solutions.

From 2009 to 2011, he was located in Hong-Kong for the Financial Engineering team of BNPP IP and has contributed to design advanced quantitative solutions for investment process of clients.

Since 2011, he is doctoral student at Ecole des Hautes Etudes en Sciences Sociales (EHESS-CAMS) in Paris (France). He obtained Master’s degree in Mathematics and Financial Engineering at Ecole Superieure d’Ingenieur Leonard de Vinci in Paris in 2008.

NOTES:

1. GARCH models, short for generalized autoregressive conditional heteroskedasticity models, have been widely used in financial and econometric modeling and analysis since the 1980s. These models are characterized by their ability to capture volatility clustering, and they are widely used to account for nonuniform variance in time-series data.
2. The clustering impact, at 7%, is in line with historical estimates for the S&P 500. In both charts, volatility = 18.8%, the target risk budget is chosen so as to target 18.8% of volatility for the risky assets, the target Sharpe ratio = 0.40 and 500 Monte Carlo simulations of 2 600 daily returns were used.

DISCLAIMER