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LOMBARD ODIER
INVESTMENT MANAGERS

Convexity lookout:
managing downside risk efficiently

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At a glance

- At a basic level, convexity is the asymmetry of the return profile, with gains typically larger than losses. This is clearly a desirable portfolio feature.
- Here we explore some of the common strategies investors use to introduce convexity in portfolios, beginning with a single-asset class approach such as equities, and options such as zero-cost collars.
- Dynamic drawdown management (DDM) could help reduce downside risk at a reasonable cost, in our view. Our bespoke process offers an effective way to improve portfolio efficiency, while addressing some drawbacks to option-based strategies, such as zero-cost collars.
- Diversification is then brought into play, as adding multiple asset classes to an equity portfolio boosts the asymmetry of the return profile, but careful construction is crucial.
- We review a number of examples, such as long volatility strategies, trend-following strategies, convertible bonds and crossover credit.
- In conclusion, we present a portfolio example that addresses convexity issues and provides a simple and straightforward solution.

Commonly-used convexity strategies

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We believe that downside protection and a deeper focus on convexity are key for investors.

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1. Introduction

Warren Buffett famously said his investing rules were simple. "Rule No.1: Never lose money. Rule No. 2: Never forget rule No. 1."

This might seem relatively obvious but an investor's best friend, compounding, can also become their worst enemy during difficult times. While recovering from a 50% drawdown requires a 100% return on the remaining capital, it is not inconceivable that a typical investor would probably partially divest after a 50% drawdown, pushing the required rate of return on their remaining investment even higher.

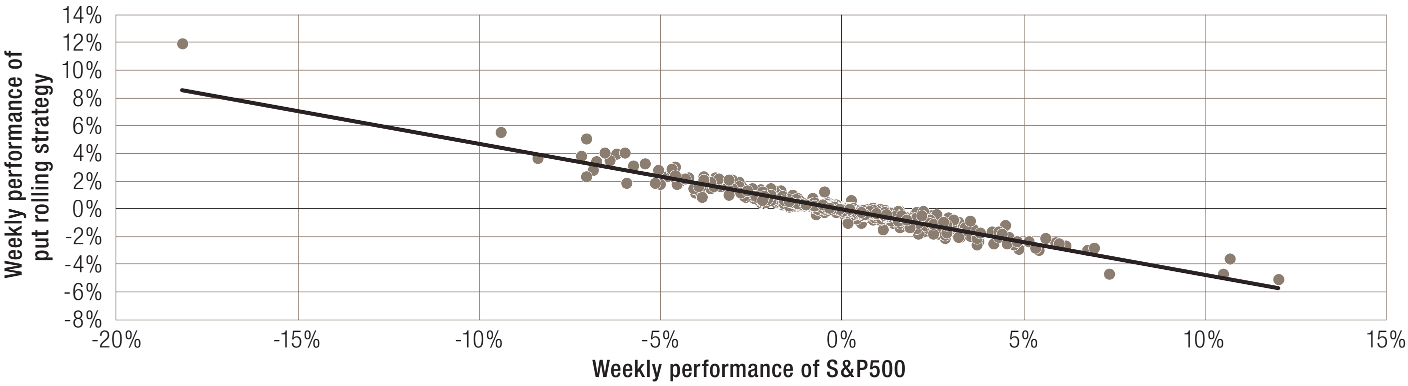
Through the years, therefore, investors have devised strategies that attempt to deploy capital more efficiently, trying to reduce the risk of their portfolio whilst preserving their potential upside participation. One such strategy consists of targeting a pre-defined volatility level. Volatility typically clusters into regimes and correlates negatively with market returns. As such, dynamically adjusting the risky assets allocation based on its recent volatility provides a simple yet powerful way to enhance portfolios' efficiency.

A more direct way to protect against downside risk lies in the option market where investors can benefit from financial instruments designed to provide any payoff imaginable. While traditional financial instruments typically exhibit a linear payoff, the two building blocks of the option market, puts and calls, have a convex payoff. However, holding an instrument with a convex payoff does not guarantee that its return stream will be convex with respect to the performance of its underlying.

To illustrate this, Exhibit 1 compares weekly returns of the S&P500 to weekly returns of a strategy consisting of rolling a one-year ATM put option. Whilst the payoff of the put is a convex function of the underlying price at maturity, the returns of the strategy are mostly linear with respect to the performance of the index.[1]

The motivation of designing a convex strategy is to bend the relationship between the index performance and the strategy performance in order to keep the downside protection (particularly extreme movements) while controlling its cost. Historically, a good candidate for building such strategies has been volatility. As can be seen in Exhibit 2, historical 1-year realised volatility displays a fair amount of convexity with respect to the index performance.

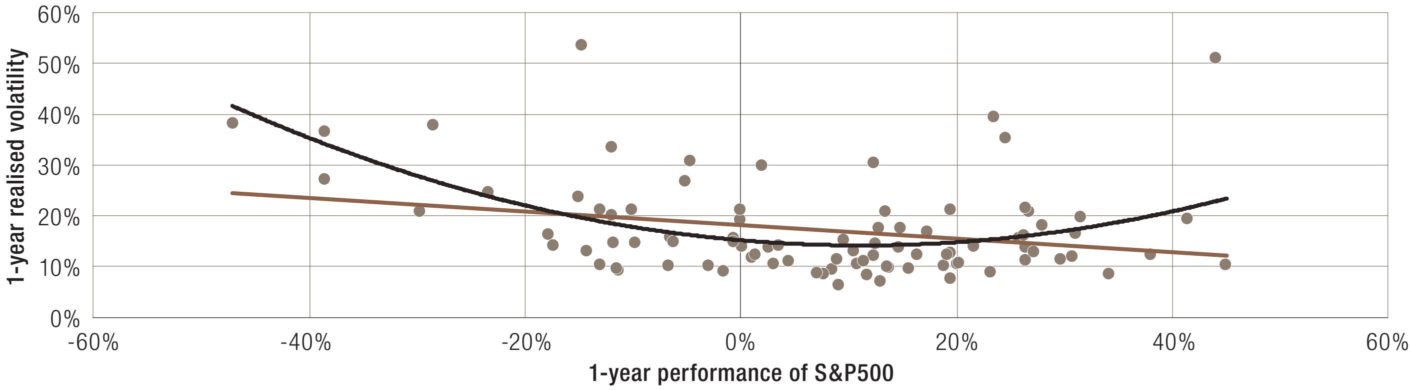
EXHIBIT 1 – CONVEX PAYOFF DOES NOT EQUAL CONVEX RETURNS



Date range: 2007-2019. Source: LOIM. For illustrative purposes only.

1 Note that this illustration is highly stylized (the loss of convexity is due to subtle calendar effects between the put rolling dates and the occurrences of drawdowns) and is not representative of all protective put options strategies.

EXHIBIT 2 – THE CONVEXITY OF VOLATILITY



Date range: 1929-2018. Source: LOIM. For illustrative purposes only.

Interestingly, large moves in the S&P500 typically go hand in hand with high realised volatility. Options traders have extensively monetized this feature for years through trades aiming to isolate the volatility exposure such as delta-hedged straddles or more recently, variance and volatility swaps. The underlying motivation of such trades is to design a payoff structure that will perform well during uncertain times at a reasonable cost. This asymmetry, typically referred to as convexity, is at the core of many trading strategies that have arisen in the last few decades. For a (regular) function to be convex, a necessary and sufficient condition is for its second derivative (acceleration) to be positive. In other words, not only does the payoff increase with the move in the underlying but the rate at which it grows increases as the underlying moves.

To conclude this introduction, we turn to implementation. When building a convex trade, investors should give most of their attention to the losing leg. Indeed, it is the one that they will have to face on a daily basis and that will eat into their capital. Not only is it psychologically difficult to sustain such a bleed but also one should not forget that the pay-out, when it occurs, would apply to the remaining capital (not the initial one!). It is therefore of the utmost importance to carefully construct the losing leg of the trade.

The structure of this note is as follows. We begin by reviewing commonly-used convexity strategies, focussing on the equity asset class – these include option-based strategies, dynamic drawdown management and trend-following strategies. We then broaden the scope of this search to multi-asset portfolios. Through a few examples, we highlight how convexity can be improved at the portfolio level. We conclude with a real-life example of a multi-asset portfolio combining the key elements presented in this note.

2. Commonly-used convexity strategies

We now turn to describing popular strategies designed by investors to improve the convexity of their portfolios.

2.1 Option-based strategies
Using the basic building blocks of the options market, investors can theoretically design any payoff.

One such popular example is zero-cost strategies that typically trade off part of the upside potential for downside protection. The simplest example consists in selling a call to finance a put, a zero-cost collar (ZCC). Once the desired protection level has been defined, the investor has to find the upside cost they will have to bear in order to finance this insurance policy. The main detractor of such a strategy is the volatility smile skew,[2] which represents the relative expensiveness of puts relative to calls mainly due to investors' behavioural biases. An investor setting up a ZCC program will therefore find themself short the skew as they will have to give up more upside than the downside protection. To illustrate, a typical strike for the call would be around 107% for a 10% out-of-the-money (OTM) put.[3]

Another way to structure a zero-cost trade is to buy a 2x1 put-spread. The investor will typically buy two deep OTM puts financed by selling one put closer to the money. The trade can easily be made costless by playing with the strikes of the puts, but once again, the investor finds themself short the skew. The structure can be refined by shifting the risks around to reduce the premium paid. For example investors could harvest a calendar spread premium by selling shorter-dated puts while buying longer-dated ones. Another way to reduce the cost is to implement the trade through a basket of options on the main index constituents instead of options on the main index itself.[4] Doing so, investors shuffle risk around, in this case correlation risk, and reduce the protection premium. One should, however, be extremely cautious when structuring such trades as introducing various sources of risk to reduce overall cost can actually render the trade fragile to overfitting and rare events.

Another way to access option-like payoffs are so-called option replication strategies. Here, instead of purchasing an option from a broker, its delta is replicated by dynamically allocating to the underlying. This is the basis of option pricing theory (e.g. Black-Scholes formula) and can be deployed physically to disintermediate the option provider. However, friction costs (transaction costs, financing, etc), not to mention the modelling and pricing infrastructure required, render this approach very hard indeed in practice.

Finally, it is important to note that those strategies owe their performance to two entangled drivers: the dynamic delta they carry and their volatility exposure. Indeed, as the options are not delta-hedged, their delta varies with their underlying and (partially) offset (or add up) to the portfolio delta. Investors need to decide whether they desire, or not, these features.

2.2 Dynamic drawdown management
Asset returns volatility has been the subject of a large body of research over the last 30 years or so. One of the most prominent features of volatility is its tendency to cluster, meaning that high volatility periods tend to be followed by high volatility periods and low volatility periods tend to be followed by low volatility ones. Another well-known feature is the negative correlation typically observed between volatility changes and market performance. This stylized fact is known as the leverage or LeBaron effects.[5] Those two characteristics of volatility open the door to a simple yet powerful way to reduce drawdowns by allocating dynamically between a risk-free and a risky asset. This is the basis of dynamic drawdown management (DDM) techniques.

This enhances convexity in portfolio by cutting downside risk whilst not limiting the upside. It is achieved through a dilution into cash, which cuts losses and thus, once the storm abates, the portfolio can return to full investment and be fully exposed to market rebounds. Furthermore, particularly relevant for multi-asset portfolios is that multi-asset options tend to be less efficient because they are less liquid than equity index options – therefore transaction costs can be high. In contrast, since DDM operates primarily using liquid, market-standard derivatives,[6] it can control transaction costs much better.

Contrary to option strategies where the cost is determined upfront, and crystallised regardless of whether the protection is actually used or not, the cost of DDM is realised ex-post, once protection has in fact been used and is quantified by the extent to which the portfolio is underexposed to the risky asset and consequently misses on rebounding markets. At LOIM we have carried out extensive research to cheapen this cost and have implemented several improvements in our portfolios since 2013.

[2] Also called smile (typically in FX or rates options markets) or smirk due to its shape.

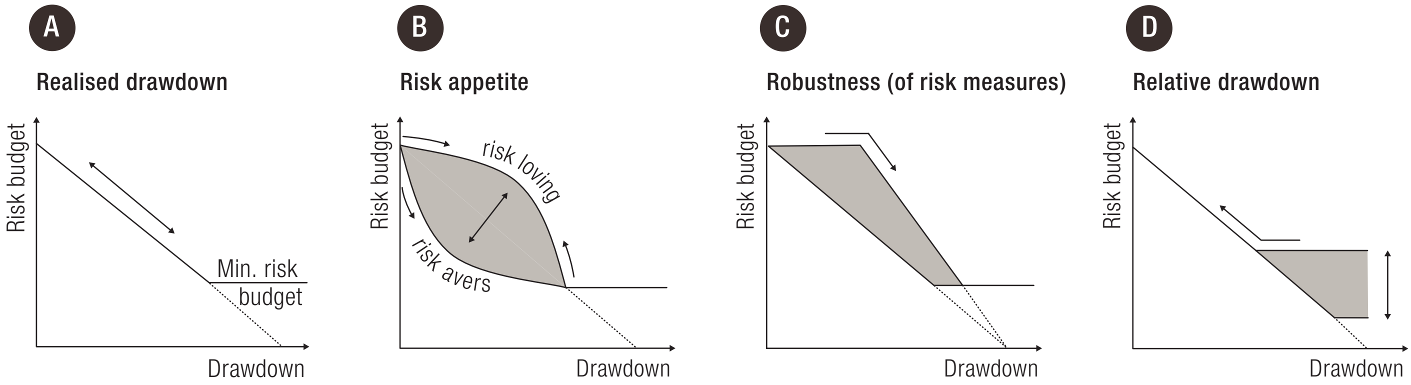
[3] In this case, the investor is giving up any gain above 7% to avoid losses greater than 10%.

[4] For example, trading a basket of 2x1 put spreads on CAC40, DAX, IBEX and FTSE MIB instead of a 2x1 put spread on the EuroStoxx 50 might be cheaper due to the correlation risk taken by the investor.

[5] See e.g. B. LeBaron, 1992. "Some relations between volatility and serial correlations in stock market returns." J Bus, 65(2),199–219, or Aït-Sahalia, Y., J. Fan & Y. Li, 2013. "The leverage effect puzzle: disentangling sources of bias at high-frequency," *Journal of Financial Economics* 109, 224-249.

[6] Typically, futures.

EXHIBIT 3 – THE FOUR COMPONENTS OF DYNAMIC DRAWDOWN MANAGEMENT



Source: LOIM. For illustrative purposes only.

Today, our DDM process entails four different components to size the amount of risk to be deployed at any point in time: the portfolio realised drawdown, the current market risk appetite, the reliability (or robustness) of risk measures and the performance lag (or "relative drawdown"), as illustrated in Exhibit 3.

A. Realised drawdown (Exhibit 3 A)

Initially inspired by a CPPI approach,[7] this initial step sets a downward-sloping relationship between risk budget and realised drawdown (computed over a 12-month rolling window): the larger the realised drawdown from previous 12-month peak, the less exposure we allow in order to ensure we avoid continued weaknesses and larger losses (in the return distribution tail). For example, starting with a 10% risk budget, we will simply reduce the remaining available budget to 7% in case of a 3% realised drawdown.

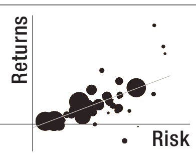
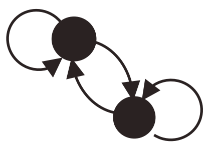
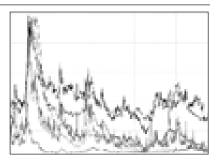
Contrary to traditional CPPI approaches, we set a floor to the risk budget (minimum risk budget) in order for the portfolio to remain invested at all times, so that it can progressively recover once a drawdown reaches its trough. In turn, this removes the capacity of the policy to guarantee capital protection, merely targeting pre-defined drawdowns. Nevertheless, such a strategy has a potentially high cost of implementation, which we understand as a sort of "insurance premium" to be paid for, in order to limit losses and concretely paid as a lower average performance. In order to limit this cost, we have developed several techniques presented in the following three charts (Exhibit 3 B-C-D).

B. Risk appetite (Exhibit 3 B)

Instead of following a straight line, as shown in 3A, we define a curved path to risk budgeting by using a proprietary risk appetite indicator (RAI): the lower the market risk appetite, the more conservative the risk budgeting (convex curve on Exhibit 3 B), the higher the RAI the more permissive the risk budgeting (concave curve on Exhibit 3 B). This curved-shaped path enables a better reactivity and also helps avoiding unnecessary trading in stable/supportive market conditions, implicitly lowering the cost of the overall risk budgeting strategy.

The RAI, which was developed and calculated internally, looks at a range of complementary market indicators, in line with our philosophy of diversifying model risks whenever possible. We adopt here a set of measures with varied investment horizons, either backward-looking, contemporaneous or forward-looking indicators, as shown in Table 1.

TABLE 1 – RISK APPETITE INDICATORS – VARIOUS INVESTMENT HORIZONS

MODELS	CAPITAL MARKET LINE	REGIME SWITCHING	MARKET-BASED
HORIZON	Backward-looking	Contemporaneous	Forward-looking
DATA	Monthly returns and volatilities of major asset classes	Weekly returns and daily volatilities of major asset classes	Swap spread, TED spread, credit spreads, VIX, implied FX volatility
ILLUSTRATION			

Source: LOIM. For illustrative purposes only.

[7] See e.g., Black, F., Jones, R. C., 1987. "Simplifying portfolio insurance." *Journal of Portfolio Management* 14 (1), 48–51.

Exhibit 4 illustrates a lower RAI implies a convex curvature while a positive RAI implies a concave curvature – the stronger the signal the stronger the curvature (each way).

C. Robustness of risk measures (Exhibit 3 C)
The next improvement to risk budgeting is based on our assessment of risk models' reliability, in particular the various volatility models we use in estimating risk. While the RAI adjustment presented above is considered as externally-driven (i.e. depends directly on market risk conditions), the robustness adjustment is internally-driven in the sense that it depends on an objective appraisal of our proprietary risk models.

The objective is to reduce (increase) the risk budget when model uncertainty increases (reduces): this can be thought of as a volatility of volatility, meaning that when measures are dispersed and/or unstable, models are altogether less reliable and risk budgeting should be tighter.

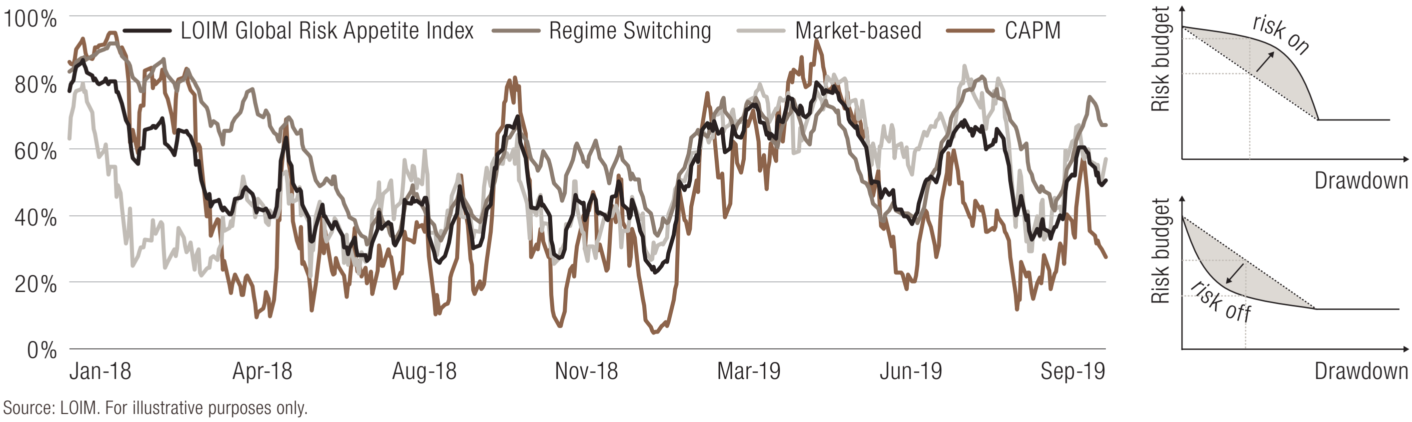
D. Relative drawdown (Exhibit 3 D)
The last improvement we apply is called "relative drawdown" in the sense that it compares on a daily basis the relative performance of our invested portfolio (using drawdown management) to a virtual portfolio always fully invested (i.e. not using drawdown management): as this lag increases (decreases), the risk budget is increased (decreased). Concretely, we implement this by moving up the minimum risk budget floor above the initial lowest level set at 1/3rd, which forces to redeploy assets in the markets.

In a way, this mechanism helps avoid a sort of inherent "complacency" that appears when being underinvested and in control of risk, while the markets return into a positive performance trend. This represents the moment when such risk control strategies lag most and thus pay their insurance premium, after having protected from heavy losses.

All four risk budgeting techniques are updated and monitored daily and the applicable risk budget is derived accordingly.

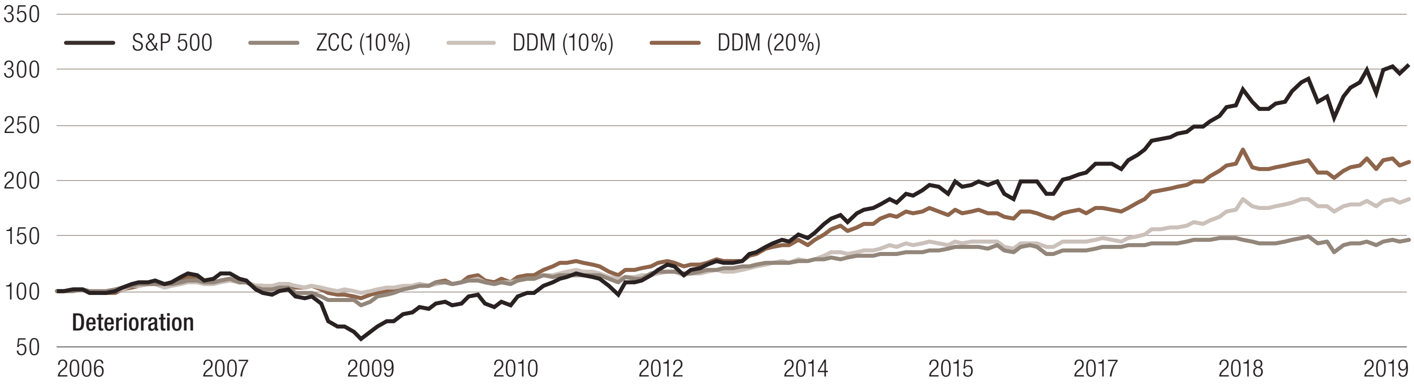
To illustrate, we compare our DDM strategy with a zero-cost collar strategy described previously, as was proposed to one of our clients. In this instance, the investor buys, on a rolling annual basis, a put option struck at 90% (i.e. 10% below ATM) which is funded by the sale of the appropriate call option with the same maturity (the call strike varies over time but hovers around the 107% mark). While this particular form of ZCC is overly simplistic and can be readily improved in several respects, it serves already to highlight some of the inherent differences with an alternative such as DDM. Exhibits 5 and 6 summarise the performance of both strategies. We run two versions of the DDM strategy, one with a maximum DD budget that is comparable with the put strike (90%) and one with similar ex-post risk budgets (20%).

EXHIBIT 4 – RELATIONSHIP BETWEEN RISK APPETITE INDICATOR AND RISK BUDGETING CURVATURE



Source: LOIM. For illustrative purposes only.

EXHIBIT 5 – A SIMPLE ZERO-COST STRUCTURE ON S&P500, 2006-2019: COMPARISON WITH DYNAMIC DRAWDOWN MANAGEMENT



Source: LOIM. For illustrative purposes only. Past performance is not a guarantee of future results.

EXHIBIT 6 – A SIMPLE ZERO-COST STRUCTURE ON S&P500, 2006-2019 & COMPARISON WITH DYNAMIC DRAWDOWN MANAGEMENT. PERFORMANCE STATISTICS

	S&P 500	ZCC (10%)	DDM (10%)	DDM (20%)
PERFORMANCE (ANN.)	8.5%	2.8%	4.5%	5.8%
VOLATILITY (ANN.)	14.4%	5.7%	5.1%	7.4%
SHARPE RATIO	0.47	0.21	0.56	0.56
MAX DRAWDOWN	-51.9%	-21.2%	-9.2%	-17.2%

Source: LOIM. For illustrative purposes only. Past performance is not a guarantee of future results.

We make three comments comparing DDM to the ZCC strategy.

1. **Opportunity cost.** The sale of calls incurs a high opportunity cost, penalising the performance especially in bull markets, which results in substantial loss of performance versus unhedged exposure (+2.8% versus +8.5%). Since it does not sell calls upfront, DDM does not cut the upside on an ex ante basis, albeit it has a cost, as does any insurance/hedging policy. However, this cost can be less than that of ZCC, as illustrated in Exhibit 6: depending on risk budget (10%, similar to put strike, or 20%, similar to ex-post risk budget), the cost is reduced by up to half.
2. **Roll risk.** Despite the put strike being only 10% out of the money, the realised worst drawdown is -21%, illustrating the additional risk linked to reinvestment (rolling of the puts) – buying a 90% put after suffering a 10% loss (exercise of previous 90% put) can result in another 10% loss. This is typically what happened in 2008. DDM better controls this risk as it continuously locks in a high watermark to determine the worst 1Y DD. With a comparable risk budget, the maximum drawdown suffered by the DDM strategy with 10% risk budget is 9.2%, compared to 21.2% for the ZCC overlay.
3. **Basis risk.** Finally, given that options only reference passive indices, such a hedge precludes the recourse to active or semi-active strategies to deliver alpha. In the case of DDM on the other hand we are able to harvest this potential additional performance: indeed, since the worst drawdown is measured from the high watermark of the actual portfolio, any excess performance over the market is automatically taken into account in the DDM overlay.

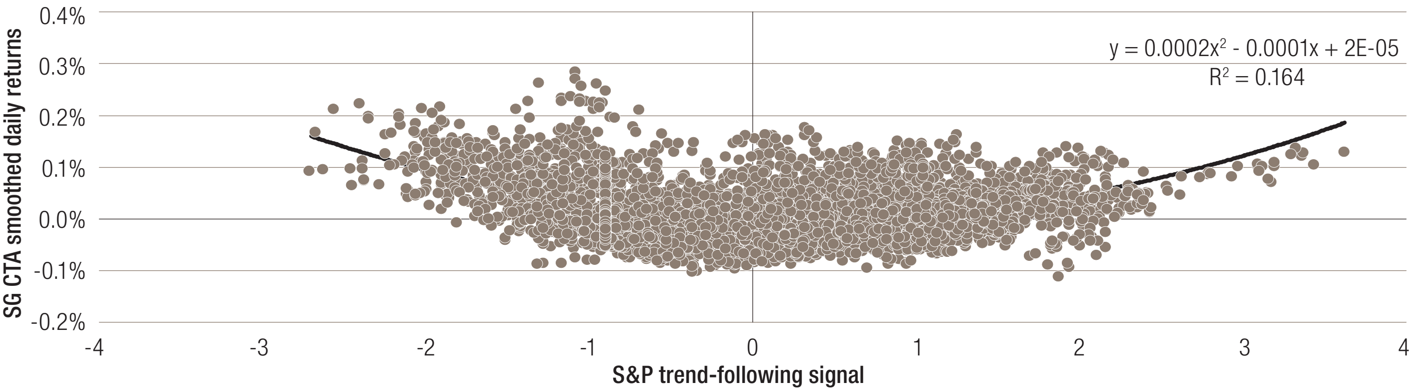
In summary, we believe DDM provides an effective way to improve portfolio efficiency while addressing some of the issues that befall option-based strategies such as ZCC.

2.3 Trend-following strategies

One interesting feature of trend-following strategies is their inherent convexity. Trend-following strategies work by dynamically going long or short an asset class based on its recent price movement. While this can be implemented on a single asset class (such as equities), such strategies are typically implemented on a portfolio of diversified assets covering some or all of the following: equity indices, sovereign bonds, currencies, commodities and sometimes credit indices. The performance of trend-following strategies can be ascribed to the difference between long-term and short-term realized variance.[8] The convexity of such a strategy return stream is illustrated in Exhibit 7 by a scatter plot of exponentially smoothed daily returns of a basket of momentum funds (represented here by the Société Générale CTA index) versus a 180-day S&P 500 Index trend-following signal.

[8] See e.g., T.-L. Dao, T.-T. Nguyen, C. Deremble, Y. Lempérière, J.-P. Bouchaud, M. Potters, 2018. "Tail protection for long investors: Trend convexity at work." Risk.net, Volume 7, Number1,61-84.

EXHIBIT 7 – THE CONVEXITY OF TREND-FOLLOWING STRATEGIES



Date range: 2000-2019. Source: LOIM. For illustrative purposes only.

Harry Markowitz's famous adage that "diversification is the only free lunch in finance" gave birth to a wide range of strategies betting that the cross-asset correlation structure would play in investors' favour during market stress. This led naturally to focus on multi asset portfolios as a means to better control downside risk of a pure equity portfolio. We now turn to this approach and discuss how convexity can be enhanced through that route.

3. Diversification

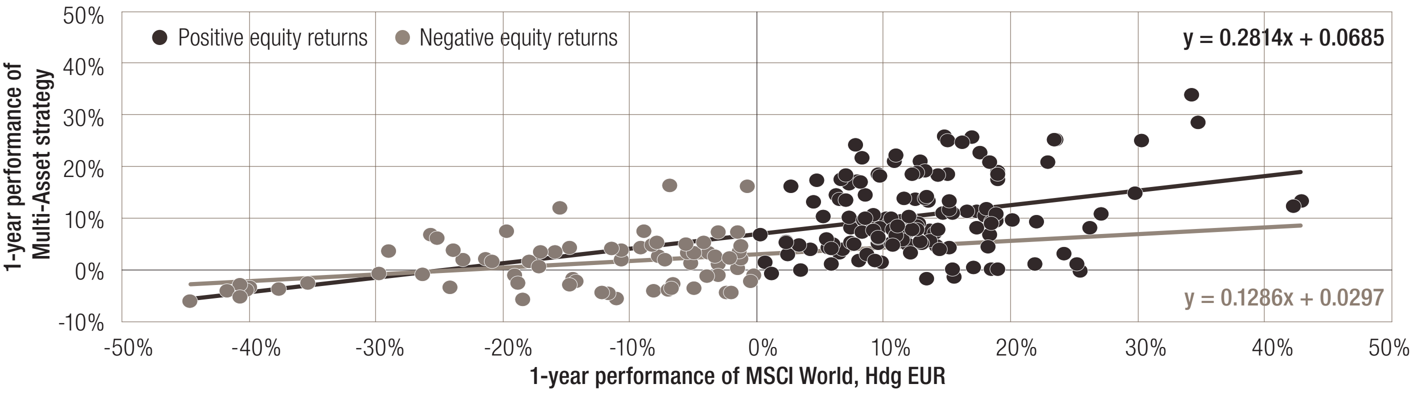
Diversifying an equity portfolio to multiple asset classes has its own kind of benefits. Indeed, taking advantage of the correlation structure of cross-asset returns allows investors to reduce the portfolio volatility without having to leave capital on the sidelines. A traditional example is the 60/40 portfolio, which allocates 60% of capital to fixed income securities and 40% to stocks.[9] The underlying assumption that sits at the core of such portfolio construction is the negative correlation between stocks and bonds that has prevailed over the past 30 years. Investors opting for such a portfolio believe that this negative correlation will allow them to harvest most of the equity risk premia whilst smoothing the worst equity drawdowns thanks to their bond allocation. Furthermore, applying dynamic drawdown management techniques similar to what we have described above[10] also helps reduce downside risk whilst preserving upside participation, thereby delivering higher risk-adjusted returns, or higher Sharpe ratios. The importance of higher Sharpe ratio portfolios resides in the fact that such portfolios deliver the same returns with less risk, or more returns with the same amount of risk, a particularly useful feature especially if risk can be sized relatively freely (i.e. through the use of leverage).

As an illustration, Exhibit 8 compares the rolling 12-month returns of LOIM's flagship multi-asset strategy versus rolling 12-month returns of global equities. The relationship between these return streams is not constant: in upside markets, the relationship is steeper than in downside equity markets. Hence, a higher participation rate can be achieved in positive markets than in negative ones, a form of convexity that multi-asset portfolios can provide better than pure equity portfolios.

In our view a multi-asset portfolio can provide meaningfully more convexity than a pure equity portfolio provided it integrates the following principles:

1. Portfolio construction is key. After a few years of rising stock markets without real pitfalls, and as the level of rates remains low overall, we consider it imperative to favour diversification (rather than concentration) and a nimble and dynamic allocation process. Risk-based allocation is particularly well suited as it is avoids concentration risk commonly found in capital-based portfolios, in our view. In markets disrupted by often unpredictable factors (especially geopolitical), it is essential to enhance the portfolio with a dynamic drawdown management process, in order to protect against extreme losses and thereby improve the portfolio convexity.
2. Incorporate direct and funded alternative strategies that focus on convexity through careful trade construction. Examples include strategies narrowing on specific markets, such as credit relative value, or fundamental equity long-short, specifically designed with a focus on building convex payoffs, can also be attractive in this context. Also, as illustrated previously, trend-following strategies can also offer a relatively simple source of convexity. Hedging strategies sourcing a long volatility exposure (Exhibit 2) can be particularly helpful and will be addressed later in this paper.
3. Select asset classes or sub-asset classes that themselves display convexity properties. Two such examples include convertible bonds and crossover credit which we will detail next.

EXHIBIT 8 – MULTI-ASSET STRATEGY RETURNS VERSUS EQUITY RETURNS



Date range: 2000-2019. Source: LOIM. For illustrative purposes only.[11]

[9] Here we will use the European version of the 60/40. The proportions are usually reversed for US investors due to a higher risk appetite.

[10] Indeed these DDM techniques were first developed at LOIM in the context of diversified portfolios.

[11] These performance results are backtested based on an analysis of past market data with the benefit of hindsight, do not reflect the performance of any LOIM product and are being shown for informational purposes only. While the results presented are based on certain assumptions that are believed to reflect actual trading conditions, these assumptions may not include all variables that can affect, or have affected in the past, the execution of trades. The hypothetical portfolio results are based on the following assumptions: 1. The hypothetical portfolio record does not include deductions for brokerage commissions, exchange fees, or slippage; 2. It assumes purchase and sale prices believed to be attainable. In actual trading, the prices attained may or may not be the same as the assumed order prices; 3. The portfolio results do not take into account any tax implications arising from the sale or purchase of securities, which in actual trading do have an impact on gains and losses.

We now turn to three examples asset strategies and asset classes that display interesting convexity properties and that can advantageously be incorporated into multi-asset portfolios: long volatility strategies; convertible bonds; and crossover credit.

3.1 Long volatility strategies

At LOIM we have spent considerable time researching ways to further reduce the opportunity cost of dynamic drawdown management (DDM). The basic premise of this research was that while DDM was able to protect the portfolio in most circumstances, it was likely to suffer in certain specific market environments, such as a market crash. Furthermore, it was likely to suffer costs in range-bound markets, or sharp rebounds, such as were witnessed in January and February 2018. Therefore, it was interesting to complement it with a hedging strategy that would be benefit in such environments.[12] We summarise our findings in Exhibit 9.

Our research centred on sourcing the appropriate volatility exposure. Volatility is often thought to be a single, holistic measure of risk. Volatility is actually much more than that, probably closer to a second-order market sitting atop traditional asset classes. Be it realised or implied, with various sampling frequencies or anywhere on its term-structure, volatility can take many forms and exploiting its many features is a subtle art still in its infancy. Financial engineering progress over the last 3 decades has considerably widened the set of instruments available to trade volatility, but most of this progress has been focused on equity implied volatility and its term structure. Each asset has a continuum of realised volatilities, depending on the observation window and the sampling frequency, and a continuum of implied volatilities, depending on the maturity and the moneyness of the associated option.

Multiple approaches are available in the market to exploit these variations of volatility, ranging from intraday realised volatility exposures (sampling frequency diversification), implied volatility exposure (dynamic position sizing to avoid high carry cost of simplistic rolling of VIX futures) and (downside) variance strategies that benefit from rising volatility at low cost by actively delta-hedging positions to extract pure volatility exposure.

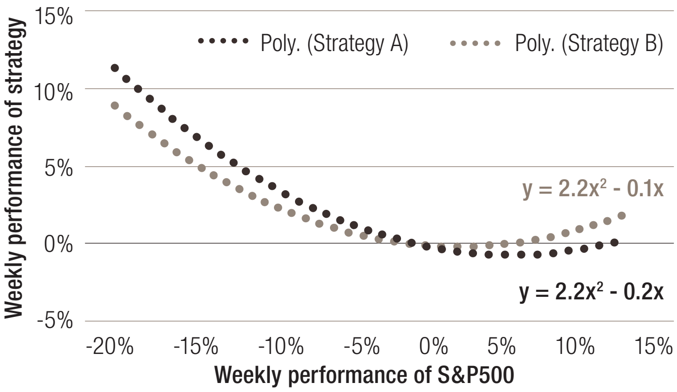
Of key importance is the careful design of the strategy, which we illustrate in Exhibit 10. We compare two strategies that both aim at investing in equity implied volatility through derivatives instruments when it is rising, similar to a (one-sided, long-only) trend-following strategy. Strategy B has the added refinement that it is accounting for the negative correlation that typically prevails between volatility and market performance during quiet periods. We observe this correlation bias quite clearly in the scatterplot (polynomial fit shown for clarity) where weeks with small gains for the S&P500 tend to translate into losses for Strategy A whilst the improved version is barely below the breakeven line. Moreover, this effect generates a cost through an implicit short beta position. Over time, this cost adds up meaningfully while the marginal loss in convexity of Strategy B does not seem to have a meaningful impact. In our opinion, Strategy B is a much better convexity play as it allows carrying the position for a long time, with a positive performance whilst preserving most of the convexity with respect to the underlying equity index. Moreover, investors could slightly leverage their position in Strategy B to reach a similar or higher convexity profile than the initial one, whilst benefitting from a positive long-term performance.

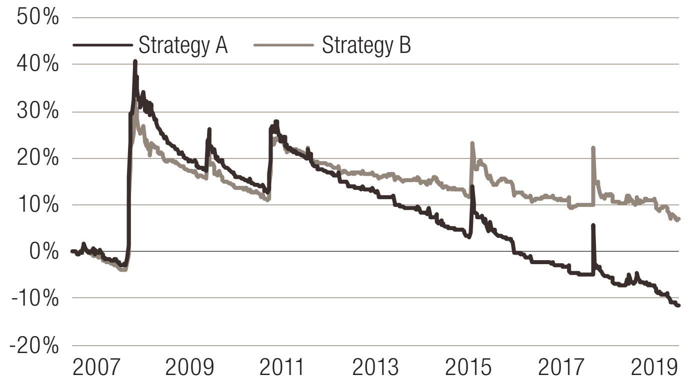
EXHIBIT 9. SUMMARY OF DDM RESEARCH FINDINGS ACCORDING TO SPECIFIC MARKET ENVIRONMENT

		SECULAR BEAR MARKET	SECULAR BULL MARKET	RANGE-BOUND MARKET	MARKET CRASH
HIGH VOLATILITY REGIME	**DDM**	Cuts exposures and does not cost until rebound	Potential marginal cost due to market instability	When triggered, cost can dominate savings (e.g. 2018)	Models capture changes potentially too late
	DESIRED HEDGING STRATEGY FEATURE	Positive contributions overall	Positive contributions overall	Makes moderate gains due to realised volatility and reduces the likelihood to trigger DDM	**Makes important gains** due to realised volatility, mitigates losses from long beta portfolio, limits use of DDM
LOW VOLATILITY REGIME	**DDM**	Cuts exposures and does not cost until rebound	Not activated, no/low cost	Is unlikely to be triggered	
	DESIRED HEDGING STRATEGY FEATURE	Flat carry (e.g. options expire ITM)	Negative carry (e.g. options expire OTM)	Makes small gains due to realised volatility	

[12] Target performance/risk represents a portfolio construction goal. It does not represent past performance/risk and may not be representative of actual future performance/risk.

EXHIBIT 10 – THE COST OF CONVEXITY





Date range: 2007-2019. Source: LOIM. For illustrative purposes only.

3.2 Convertibles

A convertible bond is a corporate bond (with a coupon and a fixed-maturity date) with an option that allows the holder to convert the bond into the common stock of the issuing company (or the stock of another entity in the case of exchangeable convertible bonds) at some point in the future. The number of shares into which each bond can be converted and the conversion price are set at the time of issuance. Therefore, they generally exhibit both equity and fixed income characteristics. Depending on valuations and market conditions, a convertible bond may act more like a stock or more like a bond at any given time. Convertible bonds are described as “balanced” when they combine a relatively large bond component (or “bond floor”) and meaningful equity sensitivity (or “delta”). These balanced convertible bonds are particularly attractive to investors, such as the LOIM convertible bond team, who aim to maximise the asymmetrical return profile of their portfolio. Over the long term, the convex nature of convertible bonds has enabled them to offer equity-like returns but with much lower volatility and reduced drawdowns. Today, we believe the case for investing in actively managed global convertible bonds is particularly compelling:

- Historically, convertible bonds have been less sensitive to moves in interest rates
- We expect convertible bonds to benefit from rising-but-volatile equity markets[13]
- Increasing concerns over inflation, asset valuations, central bank decisions or the impact of rising trade protectionism are likely to make risk-conscious investment approaches increasingly attractive to investors

3.3 Crossover credit

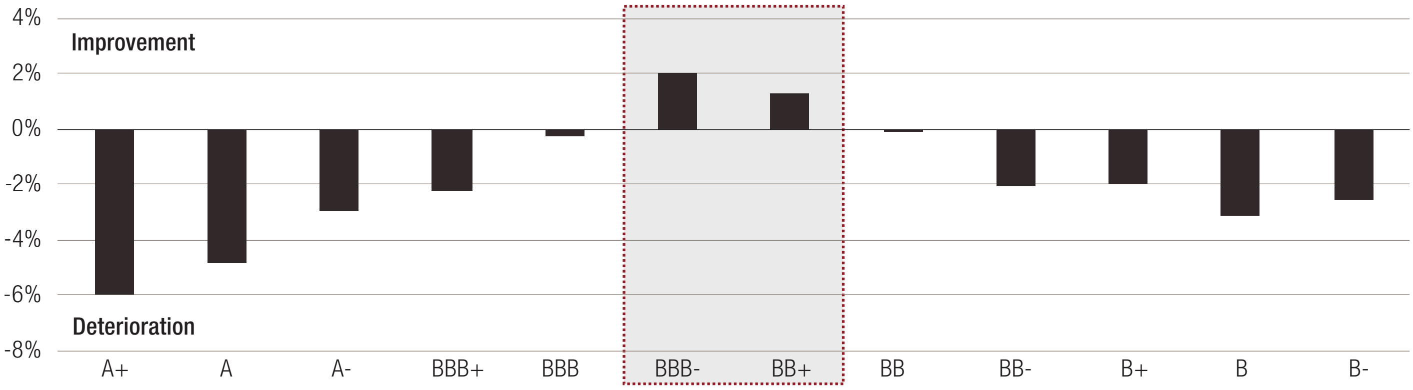
Credit as an asset class typically resists well to late-cycle dynamics, particularly if the economic slowdown is not followed by a recession – the risk of which we estimate remains low at present. Within credit, the crossover segment (comprised of issuers rated BBB to BB) is particularly well-suited to offer convexity, we believe. In addition, our Fundamental Fixed Income approach, which selects issuers based on quality and trades less, further enhances the quality of our portfolios and mitigates the risk of drawdowns.

Two main arguments support the attractiveness of the BBB-BB sector. First, it is typically composed of issuers that are more creditor-friendly than either higher-rated issuers (that are liable to engage in shareholder-friendly activity, such as corporate buybacks or increased dividends) or lower-rated issuers (that are more exposed to rising interest rates and higher default rates) – see Exhibit 11. Furthermore, the BBB-BB segment offers the best spread return of the credit universe, both on a stand-alone basis as well as on a relative basis, see Exhibit 12 – a truly convex feature.

[13] Target performance/risk represents a portfolio construction goal. It does not represent past performance/risk and may not be representative of actual future performance/risk.

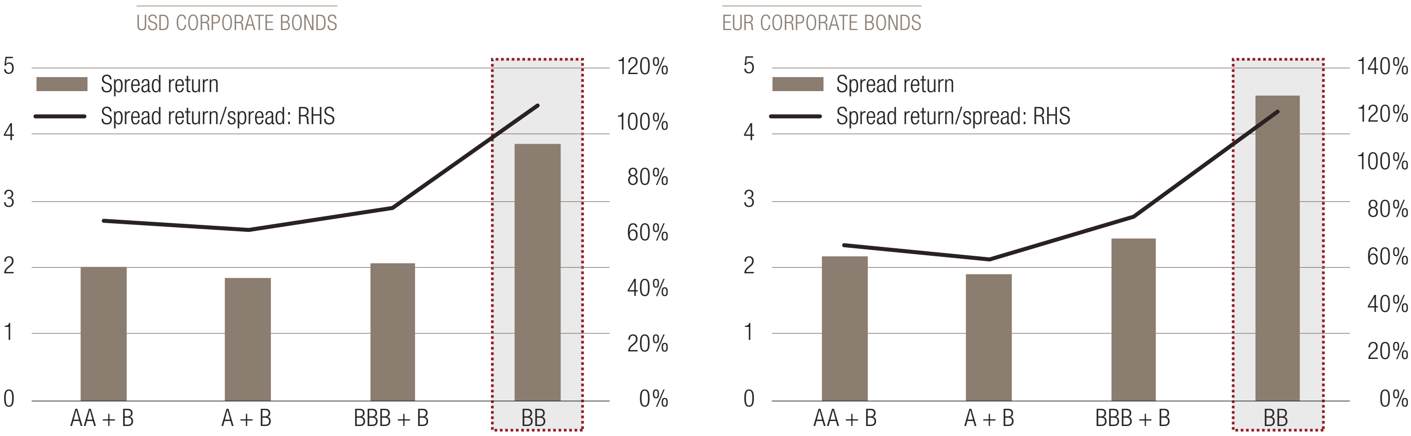
EXHIBIT 11 – IMPROVEMENT OF FUNDAMENTAL CREDIT QUALITY (1983 TO 2018)[14]

Measured as annual upgrade rate (%) less downgrade rate (%) from Moody's



Source: LOIM calculations. Past performance is not a guarantee of future results. There is a overall net downgrade rate as companies in general deteriorate in quality over time.

EXHIBIT 12 – BARBELL STRATEGIES VERSUS BB'S: SPREAD RETURNS (JUNE 2004 – SEPTEMBER 2019)



Source: Barclays POINT and LOIM.
Note: Average total returns and spread returns from June 2004 to Oct 2018. Barbell strategy assumes a fixed allocation between B and IG rated indices that matches the spread of BB rated index.
Past performance is not a guarantee of future results.

3.4 A multi-asset example

To conclude, we present an illustrative multi-asset portfolio, representing, in our view, the best approach to deliver stable long-term returns.

We assume a typical balanced profile with a target return of cash +4% and a maximum one-year drawdown tolerance of 10-15%. We build the relevant portfolio using our risk-based allocation methodology. Today, this would imply a portfolio with the following allocations across asset classes:

THE PROPOSED PORTFOLIO

EQUITIES	Global equity	35%	35%
FIXED INCOME	Sovereign bonds Corporate credit	35% 15%	50%
CONVERTIBLES	Global convertibles	15%	10%
ALTERNATIVES	Equity long/short	10%	5%

Source: LOIM. Holdings and/or allocations are subject to change.

This portfolio would be structured using both physical (cash) and derivative instruments, with differentiated investment horizons: a structural long-term portfolio combined with a dynamic, short-term allocation. This would allow us to implement our dynamic drawdown management process to manage downside risk by actively adjusting allocations as market conditions require.

Meanwhile, long-term strategic allocations with physical implementation harvest convexity through convertible and global credit allocations. Alongside global equities and fixed income allocations, our Terre-Neuve sustainable equity long/short strategy is, we believe, a very relevant addition to the portfolio construction. The Terre-Neuve strategy seeks to generate uncorrelated returns from understanding sustainability concerns (environmental, social, governance, management, accounting) and how they intersect with other value drivers. We believe this helps better ascertain quality issuers and avoid value traps.

[14] Moody's Annual Default Study: Corporate Default and Recovery Rates, 1920-2017.

4. Conclusion

Convexity, or achieving asymmetry in the return profile, is particularly relevant today. Put simply, investors seek to win more when they are right, than lose when they are wrong.

After a few years of rising stock markets, and with the level of rates remaining low overall, we expect long-standing relationships between the main asset classes to come under pressure. Against this backdrop, we believe that downside protection and a deeper focus on convexity are key for investors.

This paper has reviewed some of the common strategies used to achieve convexity, beginning with a single-asset class approach such as equities. Diversification is then brought into play, as adding multiple asset classes to an equity portfolio boosts the asymmetry of the return profile. We highlight how dynamic drawdown management could help reduce downside risk at a reasonable cost, and which specific asset classes or strategies could further tilt the portfolio towards additional convexity.
To conclude, we present an example portfolio that combines the ideas presented in this note.

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