SEQUENCING THE STRATEGY GENOME

Risk Premia

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RISK PREMIA

Sequencing the strategy genome

Risk premia strategies seek excess compensation for accepting identified risks beyond traditional broad market beta. They can be considered the building blocks of active strategies of all kinds, including many hedge fund strategies. The Barclays Capital Risk Premia family is a systematic framework for identifying cross-asset class risk premia. This report offers a practical rather than theoretical approach, building on our experience of liquid, tradable index products.

Risk premia: Why should investors care?

Risk premia strategies are simple, systematic investment strategies that include many popular styles such as carry, value, and momentum. We show that they:

- Expose and isolate the underlying sources of returns beyond traditional beta,
- Provide new sources of excess returns intuitively motivated by economic theory,
- Exhibit comparatively stable characteristics, such as volatilities and correlations,
- Have clear and identifiable risk profiles, and
- Are generally liquid and scalable – Cannot be "arbitraged away".

However, the appeal of simple risk premia strategies is sometimes overlooked because:

- Their isolated risk-adjusted performance over long samples is good but not exciting, and
- Like traditional beta, they can suffer substantial draw-downs when risks are realised.

Portfolio applications

These drawbacks can be managed in portfolios. Unlike many investment strategies, risk premia strategies exhibit generally low and stable correlations. Simple portfolios of risk premia – across asset classes, or risk premia types, or both – show significantly better risk and return characteristics, with lower draw-downs:

- Managers can select and allocate to risk premia strategies as a portfolio. These can form overlays for traditional portfolios or serve as total return investments.
- Allocations can be static, designed as buy-and-hold portfolios, or dynamic, building in views on time-varying premia.
- Portfolios should diversify across asset classes AND across risk premia. The Barclays Capital Risk Premia framework can be used to categorise strategies for this purpose.
- Understanding the pure risk premia strategies is essential to design more complex strategies. Pure risk premia strategies can be enhanced or even timed. Barclays Capital's family of strategy indices[1] serve as tradable examples. We show how they can be categorised within the risk premia framework and how they can be used to design portfolios of strategies.

[1] See *Barclays Capital Indices*, February 4, 2011

Risk premia strategies

This report focuses on risk premia beyond traditional market beta

A risk premium is an excess return potentially available to an investor willing to assume some identified risk. A risk premium strategy is a simple systematic (i.e., non-discretionary) strategy designed to capture that risk premium, accepting the potential for losses, should the "risk" materialize.

The most famous risk premium is perhaps the equity risk premium. While the magnitude is debated, it is generally accepted that long-term investors in the equity market earn a risk premium over the risk-free rate in compensation for the uncertainty in future equity valuations. Indeed, most traditional asset classes have associated risk premia – fixed rate government bonds (compensation for the risk of rising rates), credit (risk of default), mortgages (risk of prepayment or default), and commodities (risk of demand/supply shocks), as examples.

In this report, we focus on risk premia beyond traditional market betas. Strategies that seek to capture these "alternative" premia typically employ techniques unavailable to passive beta investors. These include non-standard and/or dynamic weightings of index constituents, use of short positions, limited use of leverage, and liquid derivatives.

This report focuses on a practical framework and is not intended as a final, exhaustive analysis. We expect to add to and refine the risk premia family through future research.

The Barclays Capital Risk Premia Family

The Barclays Capital Risk Premia framework provides cross asset class taxonomy

Many managers use risk premia in their investment process, either implicitly or explicitly. Examples include term premium in fixed income, quality trades (carry) in credit, and value stocks in equities. The Barclays Capital Risk Premia family is a systematic framework for understanding and applying risk premia strategies across asset classes. The family is divided into six risk premia categories: Carry, Curve, Value, Momentum, Emerging Markets, and Arbitrage. In each case, a natural implementation is sought in each of six major asset classes: Equities, Rates, Credit, Currencies, Commodities, and Volatility. This process forms a 6x6 grid with 20 out of 36 cells populated with liquid strategies. Figure 1 shows as an example the average annual excess returns for FY2010.

Figure 1: Barclays Capital Risk Premia family – hypothetical annualised excess returns, January 1990 to December 2010[2]

	Carry	Curve	Value	Momentum	Emerging Markets	Arbitrage	Traditional Beta (Excess Return)[3]
Equities	2.1%		2.9%	3.2%		12.0%	5.3%
Rates	11.0%	5.2%	5.6%	6.9%	7.9%		2.6%
Currencies	3.0%		2.6%	2.9%	12.4%		2.1%
Credit	4.4%	0.1%					0.4%
Commodities		25.2%	14.6%	4.3%			10.7%
Volatility	5.2%	10.1%					27.3%

Note: Strategies are statically scaled to target roughly 10% annualized volatility (traditional beta are shown unscaled). Source: Bloomberg, Barclays Capital

[2] Excess returns are indicative only, net of estimated transaction costs. Sample periods vary – see analysis below.
[3] Traditional betas reflect the excess returns of standard benchmark indices. Details of specific indices used are given later. The volatility beta is constructed as an inverse (-1x daily) version of the S&P 500 Short-Term VIX Futures index.

In this report, we use the risk premia family of strategies to analyse the properties and illustrate the diverse potential for investors. The family is US focused for now, but can easily be extended to other regions where suitable markets and instruments are available.

A common theme throughout this report is the focus on simple strategy and portfolio designs that do not incorporate any unnecessary parameters or features. The goal is to avoid any backward-looking bias in the design of strategies or portfolios. All the risk premia strategies in the family are defined in "natural" ways that could naturally have been concocted at the beginning of the sample periods. As such, we can take greater confidence in the hypothetical historical returns, and treat them to some extent as out-of-sample.

Hedge fund return sources, but not hedge fund replication

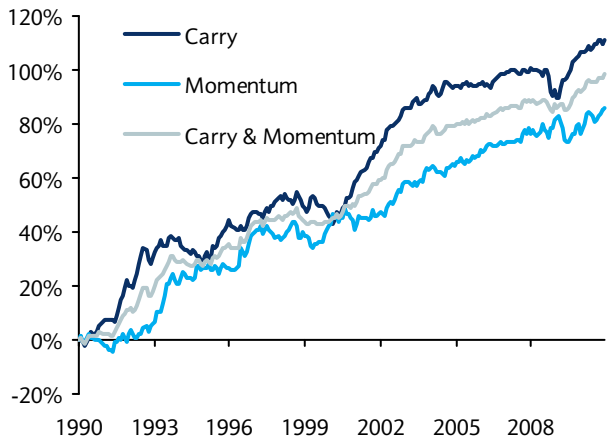
Hedge fund replication is a top-down approach – we focus on bottom-up construction of risk premia portfolios

Many classic hedge fund strategies, directly or indirectly, utilise risk premia strategies. These include obvious cases, such as currency funds exploiting FX carry and volatility funds exploiting the short volatility premium. More complex hedge fund strategies, such as diversified systematic or GTAA, can also be broken down into dynamic allocations to a large array of risk premia.

A large body of academic and industry literature discusses these themes, demonstrating that a small number of "alternative beta" factors can explain large proportions of hedge fund index returns. This leads to the idea of hedge fund replication – a top-down approach that regresses the returns of a chosen hedge fund index on identified tradable factors, and then uses those factors to attempt to replicate the returns of the index.

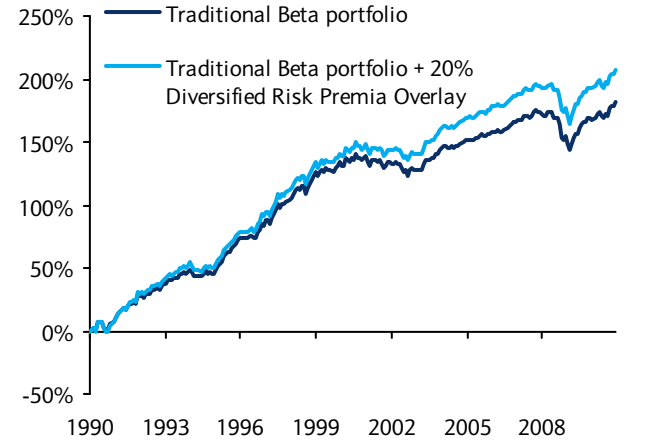
The purpose of this report is not hedge fund replication. We are interested in defining from first principles a broad set of risk premia strategies (or, in hedge fund replication terminology, "alternative beta factors"), to understand those strategies in their own right and form portfolios of them with target properties. This is a bottom-up approach – the resulting portfolios could be considered for alternative investment allocations, but are not intended to track any hedge fund index, and, in particular, do not use any regression-based allocation procedure.

Figure 2: Risk premia strategies in action – simple cross-asset class portfolios of carry & momentum risk premia, and a 50/50 combined portfolio – cumulative excess returns



Source: Bloomberg, Barclays Capital

Figure 3: Risk premia strategies in action – a diversified portfolio of 20 risk premia strategies as an overlay on a traditional portfolio – cumulative total returns



Source: Bloomberg, Barclays Capital

Applications for different investor types

The risk premia framework is a powerful tool for many investors:

- **For real money:** Diversified portfolios of risk premia can broaden the long-term return sources for traditional portfolios (see Figure 3 as an example).
- **For asset managers:** Risk premia strategies provide ideal building blocks to dynamically allocate to in a total return or overlay structure (see Figure 2 as an example).
- **For hedge funds:** Enhancing or timing individual risk premia strategies can potentially deliver new and diversifying returns.

Contents

The report is arranged as follows:

- **Identifying risk premia**
- **Taxonomy of risk premia strategies**
- **Liquid tradable implementations**
- **Properties of pure risk premia strategies**
- **Portfolio applications of pure risk premia strategies**
- **Enhanced risk premia strategies and Barclays Capital Indices**
- **Conclusion**

Identifying risk premia

The main focus of this report is the identification of alternative risk premia. Specific examples of alternative risk premia have been widely discussed and implemented. In equity markets, the size and value premia, in currencies the classic FX carry premium, in interest rates, the term premium. We propose a simple, systematic approach to define a cross asset-class family of risk premia strategies.

We propose an intuitive, fundamentally motivated, rather than statistical, approach

We start by abstracting the popular risk premia concepts beyond the asset class and implementation with which it is typically associated. For instance, we consider the generic carry risk premium, which could, in theory, be applied to any asset class, not just currencies. The second step is then to seek a reasonable implementation of the generic risk premia in each asset class, based on some principles we will discuss.

Two obvious questions arise at this stage:

i. How do we know whether a particular strategy is really a risk premium strategy?

ii. How can we be sure to span all risk premia out there?

In fact, neither of these questions has straightforward answers. We tackle the first question initially from a qualitative standpoint, as outlined below in the generic risk premia descriptions. A qualitative motivation for a risk premium is certainly a necessary requirement, but probably not sufficient. We can back up, in most cases, the qualitative argument with empirical analysis of associated strategies, demonstrating that they exhibit the expected properties. While we give limited examples of this empirical analysis in this

report, we encourage the reader to see our in-depth papers on some specific risk premia (see references in the bullets below). We do not present a more academic-style statistical justification for our risk premia.

The second question is harder as there is no scientific approach to finding a 'spanning set' of risk premia. We instead rely on a combination of academic research and our own experience of systematic strategies across the asset classes. We reviewed an extensive universe of strategies, including classic hedge fund strategies and Barclays Capital Index Strategies[4], to identify the common risk premia type themes therein.

In conclusion – both the generic risk premia we identify, and the strategies we identify as implementations, are open to healthy debate. What we propose here is our current framework – we expect this to evolve with further analysis and feedback.

Generic risk premia categories

We identify eight generic risk premia categories. The generic definition is designed to be applicable to different asset classes. To help illustrate the concepts, we give an example of a classic strategy in a specific asset class.

- **Carry**: Carry strategies seek additional compensation by going long high-yielding and short low-yielding assets from a pool of similar assets/instruments. The carry premium is in return for accepting the higher risk associated with the higher-yielding assets.

  Classic carry strategy: The FX carry strategy invests in high yielding currencies financing them in low-yielding currencies, from a basket of available currencies (such as the G10). The FX carry strategy takes on the risk of currency crashes in the investment currencies[5].

- **Curve:** Curve, or term-premium, strategies seek additional compensation for taking on the greater uncertainty associated with longer maturity risk versus shorter maturity risk.

  Classic curve strategy: The interest rate curve, or "term premium" strategy seeks a premium by investing in the longer end of the yield curve and borrowing in the front end, taking on duration risk.

- **Value:** Value strategies seek additional compensation by selecting relatively undervalued assets and shorting relatively overvalued assets in a long-term convergence trade. A premium may be available for accepting the long horizon uncertainty over timing of convergence and potentially giving up the "upside" in the interim.

  Classic value strategy: The equity value strategy is well accepted in the academic world and investment management industry. The basic form is to go overweight value stocks (high book-to-market value) and underweight growth stocks (low book-to-market). This strategy is typically understood to be a long-term strategy that risks missing out on growth-lead bull-markets. The value strategy is effectively short the "call-option" payoff profile of growth stocks, and seeks to earn that premium.

- **Momentum[6]:** Momentum strategies go long past winners and short past losers from a pool of assets, taking on the risk of sharp reversals.

[5] See *The G10 FX Carry Premium*, November 24, 2010.
[6] See our report *Liquid Momentum Strategies*, 22 February 2011 for a comprehensive analysis.

Classic momentum strategy: The momentum strategy has also been most frequently associated with stock selection, buying recent outperforming stocks and selling recent underperformers.

- **Volatility:** Volatility premium strategies seek to earn the premium available between implied volatility and realized volatility in options markets, taking on the risk of spikes in realized volatility.

  Classic volatility strategy: Systematically selling delta-hedged straddle options is a standard approach to capture the volatility premium. Where available, shorting variance swaps also provides a clean means to target this premium.

- **Emerging Markets:** Premia may be available by investing in certain emerging market instruments that are in excess of those available in the same instruments in developed markets, reflecting the increased political and economic uncertainty.

  Classic Emerging Markets Strategy: Money market rates are typically higher in emerging market currencies – a strategy which goes long emerging market deposits versus developed market deposits may be able to capture this premium, accepting the currency risk.

- **Arbitrage:** Arbitrage[7] strategies take positions in assets whose prices should converge at a future date, attempting to earn any available spread prior to convergence. They take on various forms of risk including uncertainty over the timing and completion of convergence, model-risk, financing, and liquidity risk.

  Classic arbitrage strategy: The merger-arbitrage strategy seeks to earn the premium between a target's and acquirer's stock price following a merger announcement. The premium is in compensation for the risk of the deal collapsing, among other things.

- **Liquidity**: The liquidity premium reflects the additional compensation available on illiquid instruments versus liquid ones.

  Classic liquidity strategy: Trading off-the-run Treasury bonds versus on-the-runs. Recently issued on-the-run bonds typically have higher demand, due to their liquidity and, consequently, may have a lower yield than equivalent off-the-run bonds.

Next, we expand on the above by discussing applications of these generic strategies across all the asset classes, and the many subtleties that arise in the process.

Taxonomy of risk premia strategies

Risk premia strategies seek to extract the various premia described above, in a simple but direct manner. This can be done in different asset classes and using various financial instruments. Each asset class and each set of instruments, however, present unique subtleties in terms of finding a suitable implementation which can efficiently target the desired premium. In many cases, there are also a multitude of possibilities of how to define the risk premium strategy.

[7] Note that arbitrage is really a misnomer for risk premia strategies, but a widely used misnomer. True arbitrage strategies are risk-free by definition. The strategies we discuss here, such as merger arbitrage, take clear and identifiable risks.

In this section, we discuss implementations of the generic risk premia across asset classes and discuss these issues. We first introduce a set of general guidelines and criteria that we feel should apply to all risk premia strategies.

- **Rules-based:** Pure risk premia strategies are systematic and rules based. We discuss later the discretionary management of risk premia strategies, but we define the strategies themselves to be 100% non-discretionary.
- **Simplicity:** Pure risk premia strategies should be the simplest possible implementations, with no features built in to enhance or optimize performance (we leave such features to specific enhanced risk premia strategies later). In particular, the strategies should be minimally parametric, with any essential parameter (e.g., look-back window for momentum) defined without optimization.
- **Established**: Ideally, risk premia strategies should follow a well-established strategy, (such as the "classic" implementations described in the last section), which is popular in the academic literature and in the industry. Where no established strategy exists, we look for a "natural" implementation that may be analogous to an established strategy in the same risk premia category but in another asset class.
- **Performance Agnostic:** An important and perhaps surprising criterion is no dependence on past performance. We described earlier the general properties of risk premia strategies, including the principle idea that they have positive risk-adjusted performance over long sample periods. However, we will not use positive risk-adjusted *historical* performance as a criterion for inclusion and instead rely on the economic justification for performance. This is, in part, to avoid biasing selection of risk premia strategies on the basis of relatively short historical sample periods.
- **Market-neutrality:** In general, we would like strategies to be market-neutral – i.e., to have a low correlation with the underlying asset class returns. In most cases, this is attempted by constructing the strategies as long-short, sometimes using beta-weighted short positions. However, in some examples, such as the classic rates term premium strategy which is long 10y and short 2y in equal weights, using beta weights (or in this case, duration weights) alters the risk premium interpretation, so we leave the weights 1:1.

Figure 4 presents a grid organised by risk premia in columns and asset class in rows. In each cell, we propose a strategy implementation, based on the above criteria. We leave each cell as a description rather than a precise strategy definition – these will come in the next section. The asset classes are equities, interest rates, currencies, credit, commodities, and volatility. Earlier, we introduced volatility as a risk premium. We now present it in a row rather than a column as we find natural and appealing applications of the other risk premia to volatility markets as an asset class. The volatility row is arguably itself two dimensional since, for each risk premium, we could have volatility implementations in each asset class.

Figure 4: Potential Risk Premia Strategy Implementations and Discussion

	Carry	Curve	Value	Momentum	Emerging Markets	Arbitrage	Liquidity
Equities	**Dividend Yield**	**TBD**	**Book-to-market**	**Stock momentum**	**Various**	**Merger Arbitrage**	**Firm size**
	There's no established carry concept in cash equities. Dividend yield is one possible candidate, though the nature of the carry risk premium is quite different from other asset classes.	Outside of the derivatives market, there's no obvious curve concept for stocks. See the volatility row for equity option curve premium.	The equity value strategy is well established in the academic world and in the markets. The simplest version is long high book-to-market stocks and short low book-to-market stocks.	The equity momentum strategy is also well established in the academic world and in the markets. The simplest version is long past 12 month winners and short past 12 month losers.	An emerging markets premium strategy in equity markets could be as trivial as long indices of selected emerging markets and short indices of developed markets.	Merger Arbitrage is the natural risk premium strategy, going long targets and short acquirers of announced deals.	Firm size is also well established as a risk factor in equity markets. Usually implemented as long small-cap, short large-cap stocks.
Rates	**Short-dated Eurodollar**	**Term Premium**	**Various**	**Futures momentum**	**EM Money Markets**	**Bonds vs futures**	**On- vs Off-the-run**
	Carry and curve are hard to separate here. Typically, carry is greater further out the curve. Convention classifies this as a curve premium. We may consider short-dated spreads such as the TED spread carry trades .	The classic curve premium strategy is the rates term premium. This can be applied at any point on the curve, but classically is long the 10y and short the 2y in equal weights (see notes below on market-neutrality for a discussion of duration weights).	There's no single established value type strategy in the rates world. Simple valuation models could be defined on an economic basis, e.g., on inflation expectations, or on a statistical basis, e.g., a mean-reversion model.	No particular strategy is established. Simple momentum strategies can easily be defined on different tenors of the yield curve. In this case, it is necessary to duration-weight so that past performances can be compared.	The classic emerging markets rates trade would invest in emerging money markets, and short, e.g., the dollar. Such a strategy is closely related to the FX carry strategy.	Although many classic arbitrage strategies exist in rates (e.g., bonds vs. futures, on-the-run vs. off-the-run), they are too technical, and require too much leverage, to meet our criteria.	Applied to 10y Treasuries; for example, going long off-the-run and short on-the-run bonds has been shown to attract a premium.
Currencies	**G10 FX Carry**	**TBD**	**PPP Value**	**G10 Momentum**	**EM FX Carry**	**Forwards versus cash**	**TBD**
	The FX carry trade is perhaps the most discussed and implemented of all risk premium strategies. The G10 version goes long the three highest yielders and shorts the three lowest yielders, for example.	Outside of the derivatives market there's no obvious curve concept for currencies that is distinct from the respective currency's interest rate term premium.	The established value strategy in currencies uses the purchasing-power-parity (PPP) level of the exchange rate as an indicator to select the most overvalued and the most undervalued.	Momentum is another popular strategy in currency markets. A simple G10 implementation goes long the three currencies that have appreciated the most versus the dollar over the past year and short the three that depreciated the most.	Closely related to FX carry and to emerging markets rates strategies. No single established strategy. One natural possibility is the extension of FX carry to a basket of emerging market currencies.	Technical strategies trading forwards versus cash positions are possible, but hard to implement with simple rules.	Liquidity premia in currencies will tend to overlap with emerging market risk, or smaller country currencies. No clear strategy yet to extract this premium though.

Credit	**High Yield vs High Grade**	**Credit Term Premium**	**Default Probability**	**Single-name momentum**	**EM Credit**	**Negative Basis**	**Distressed / illiquids**
	Carry is a well-defined term in the credit market, usually associated with the level of credit risk. A very simple carry strategy is to go long high yield credit and short high-grade credit.	Curve is also well-defined in credit, with liquid term structures in some bond curves and some CDS curves. A simple curve premium strategy would go long 10y risk and short 5y risk (5y being more liquid, typically, than 2y).	There are several possibilities for a natural value model in credit. The most elegant is to use a default-probability model of some kind to establish fundamental value.	Credit momentum is straightforward to define for single-name credits analogously to the equity momentum definition. Implementation may prove challenging, however, unless turnover is carefully controlled.	Several credit default swap indices track emerging market sovereigns and corporates, which could be traded versus their developed market corresponding indices in a credit emerging markets premium strategy.	The natural credit arbitrage strategy is the negative basis trade, which goes long a bond and long matching CDS protection when the spread between the two becomes sufficiently large.	Distressed and illiquid credit investments attract a clear premium in the market but require in-depth fundamental and legal technology to trade efficiently.
Commodities	**TBD**	**Deferred vs nearby**	**Scarcity/backwardation**	**Futures momentum**	**TBD**	**Physical vs Futures**	**TBD**
	Cost of carry is a key concept in commodity futures pricing, reflecting storage costs of physical commodities. However, in the context of the carry risk premium, there is no obvious strategy based on cost of carry.	The natural implementation of the curve premium strategy is to go long deferred futures and short the nearby futures. This risk premium interpretation relates to the liquidity provision in the front end, taking on the risk of supply shocks.	Various possibilities for a valuation model. Perhaps the most natural would relate to supply/demand. One example is to use backwardation as a signal of scarcity and potential undervaluation of deferred futures. Strategy goes long most backwardated and short least backwardated futures.	Momentum applies very naturally in commodities markets and is of course the original basis of the strategies of CTA funds. A simple implementation goes long nearby futures of commodities that performed best over the past year and short those of the worst performers.	The commodity markets are, by their nature, highly sensitive to emerging markets on the supply and demand side. It may be hard to disentangle these effects to create a commodity emerging market premium strategy.	The natural arbitrage strategy for commodities is the trading of physical commodities for delivery into futures contracts. However, this will probably prove impractical for a simple implementation.	Strategies based on open interest in different futures markets and the futures term structure might be available to extract liquidity premia in commodities.
Volatility	**Short straddles/variance**	**Volatility term structure**	**Implied vs Realized**	**Various**	**TBD**	**Convertible Arbitrage**	**TBD**
	Carry in volatility space is usually associated with collecting premiums from writing delta-hedged options. This can be done in any asset class with liquid options. Where available, short variance swaps provide a cleaner means to extract volatility premium.	Liquid term structures may facilitate volatility curve strategies. For example in the VIX futures market, long 6 month future and short 1 month futures, vega-neutral, is exposed to relative shocks in short term volatility.	Value is difficult to define fundamentally for volatility, but a natural, approach may be to use the implied-realized spread as an indicator of overvalued and undervalued options.	In options or volatility futures markets with sufficiently large cross-sections of comparable liquid instruments, simple momentum implementations can be easily defined based on past one year performance.	It may be possible to find suitably comparable volatility instruments in emerging markets to trade against developed market counterparts but we do not consider these in this version of the risk premia family.	Arbitrage strategies abound in the options markets. A classic example is the convertible arbitrage strategy which takes positions in a convertible bond with hedging positions in the stock to try to extract the premium in the convertible bond.	No natural liquidity strategies are apparent in volatility markets.

Note: TBD stands for "To be decided" – further discussion is required to identify a suitable strategy in these cells. Source: Barclays Capital

Further discussion points

Figure 4 raises many interesting discussion points. Clearly, there is no unique way to categorise and describe the universe of risk premia strategies – this is just one approach. But we address in the next few paragraphs some of the more common comments and issues that are raised regarding the above taxonomy.

Commonality of strategies

One immediately apparent issue with the strategies in Figure 4 is the frequent overlap of definitions, and, therefore, potentially of strategy returns. One example is the close tie between the emerging markets rates strategy and the G10 and emerging markets FX carry strategies. Simple analysis of return of these strategies does indeed reveal a high correlation (Figure 16). Another example is within the credit asset class: the carry, curve, and value strategies all share characteristics and will likely have highly correlated positions and returns.

At this stage, we do not see these overlaps as an issue. The goal is to try to map out all possible strategies. In forming portfolios of these strategies, the correlations can be taken into account, and overlapping strategies be appropriately weighted.

Rates term premium – Why not duration-neutral?

Typically, yield curve trades in the rates market (and often also in credit markets) are constructed duration neutral, by sizing the notional on the front-end position to have an equal (and opposite) duration to the position on the long end. This is done so that the trade is exposed only to the slope of the curve directly, and not to the underlying level of rates[8]. As outlined earlier, we sometimes need to relax the market-neutrality constraint so that the risk premium interpretation is maintained. In this example, a duration-neutral 2y/10y curve trade would be short about four units of the 2y for every one unit long in the 10y. No longer can we describe this strategy as extracting the additional yield available in the long end of the curve, since we are paying now four times the yield at the front end (indeed, this duration-neutral flattener would typically have a negative net yield[9]).

Momentum versus trend

We do not have a column for trend strategies. As discussed in *Liquid Momentum Strategies*, February 22, 2011, trend and momentum are similar but subtly different. Trend strategies tend to take long or short positions on particular asset, based on its recent trend. As such, the strategy is typically long or short the market. A momentum strategy goes long a basket of recent winners and short a basket of recent losers, having a lower and more complex market beta. In a sense, a momentum strategy is itself a basket of trend strategies. For this reason, in this version of the risk premia family, we have decided not to distinguish between momentum and trend.

Liquid tradable implementations – The Barclays Capital Risk Premia Family

In this next section, we take the basic risk premia strategy ideas from above and propose a subset of liquid implementations in US markets. These will form the Barclays Capital US Risk Premia Strategy family and the basis of our analysis of properties and applications in the other sections.

[8] Empirically, even duration-neutral curve trades have a (small and variable) exposure to the level of rates. Curves tend to steepen when rates fall for example, and flatten when rates rise.
[9] In fact, the duration-neutral steepener, which is of course short the 10y and long the 2y, typically has a positive net yield and could also be considered a curve risk premium strategy, but with a trickier explanation.

Criteria for defining these strategies are the following:

- Strategies should use only liquid instruments with deep markets and transparent, verifiable pricing. This generally limits us to exchange-traded instruments.
- Avoid shorting cash instruments (including liquid stocks), as this brings in not only tradability concerns, but also non-transparent costs.
- Transaction costs should be generally low, stable and roughly quantifiable (Figure 6)
- Static leverage is applied to achieve volatility in the 10% range.
- Strategies are expressed in USD in unfunded excess return format.

Clearly some of the strategies in Figure 4 are not implementable in this way, while others need to be modified appropriately. For example, the negative basis trade in credit suffers from both potential poor liquidity and a lack of pricing transparency. Volatility strategies are also limited in certain asset classes. For the cash equity strategies, we avoid shorting single-stocks and instead take only the long side (eg, high book-to-market) and short the S&P 500 futures against these to provide the notional market neutrality.

Figure 5 outlines the definitions of the liquid implementations. These can be considered version one of the family – we expect it to evolve and expand through future research.

Figure 5: Barclays Capital US Risk Premia Strategy Family

	Carry	Curve	Value	Momentum	Emerging Markets	Arbitrage
Equities	Dividend Yield	-	Book-to-market	Stock Momentum [10]	-	Merger Arbitrage [11]
	Long top 30% of S&P 1500® stocks ranked on dividend yield, short (beta-weighted) S&P 500® futures.		Long top 30% of S&P 1500® stocks ranked on book-to-market, short (beta-weighted) S&P 500® futures.	Long top 30% of S&P 1500® stocks ranked on past one year return (excl last 1 month), short (beta-weighted) S&P 500® futures.		Long target stocks listed on the NYSE, NASDAQ or ASE with deal-size at least $500mn, short (beta-weighted) S&P 500® futures.
Rates	Eurodollar Futures	10y-2y Futures	2y, 5y, 10y, 30y Mean Reversion [12]	2y, 5y, 10y, 30y Momentum [13]	EM Money Mkts [14]	-
	Long strip of four Eurodollar futures (2nd future to 5th future inclusive).	Long 10yr, short 2yr UST rolling futures, 1:1 weights.	Long highest and short lowest future (duration-weighted) based on % yield deviation from 5yr moving avg. yield.	Long winner, short loser from (duration-weighted) over the past one year.	Long 1 month deposits in 15 EM countries, equally-weighted versus the dollar.	
Currencies	G10 FX Carry	-	PPP Value	G10 Momentum	EM FX Carry	-
	Long top 3 yielders and short bottom 3 yielders from G10.		Long top 3 and short bottom 3 among G10 based on deviation from Purchasing-Power-Parity level.	Long top 3 and short bottom 3 based on total return versus the dollar over past one year.	Long top 4 yielders and short bottom 4 yielders from 15 EM currencies.	
Credit	CDX HY vs CDX IG	10yr-5yr CDX IG	-	-	-	-
	Long CDX High Yield 5y Index, short CDX Investment Grade 5y Index , 1:1 weights	Long rolling CDX IG 10y Index, short CDX IG 5y Index , 1:1 weights				
Commodities	-	3M def vs nearby	Backwardation [15]	Futures Momentum	-	-
		Long 3M deferred contracts and short (beta weighted) nearby contracts on basket of liquid commodities	Long six most backwardated (3M deferred contracts) and short six least backwardated (nearby contracts) across liquid commodities	Long past one year winners and short losers on nearby contracts across liquid commodities		
Volatility	Short Vol Portfolio	VIX term structure	-	-	-	-
	Portfolio of short volatility strategies: Short 1M S&P 500® variance, short delta hedged USDGBP, USDEUR and USDJPY straddles, short delta-hedged 3M10Y swaption straddles.	Long S&P 500® VIX Mid-Term Futures™ Index short (beta-weighted) S&P 500® VIX Short-Term Futures™ Index.				

[10] For the equity momentum strategy only, we follow the market and academic convention of recording return over the past one year excluding the last one month.
[11] This is the Barclays Capital Q-MA index
[12] Uses the Barclays Capital Targeted Exposure Futures family of indices (2y, 5y, 10y and long bond), each of which targets the same sensitivity to changes in yields. The full family of Targeted Exposure Futures indices are directly tradable via the respective iPath® exchange-traded notes.
[13] See footnote 9.
[14] This is the Barclays Capital GEMS index.
[15] This is the Barclays Capital Backwardation Long-Short index.

Source: Barclays Capital

For the purposes of the subsequent analysis, approximate transaction costs are used on the unleveraged strategies so that costs are multiplied with leverage (Figure 6). The transaction costs were estimated based on the instruments used and frequency of rebalancing in the strategy.[16]

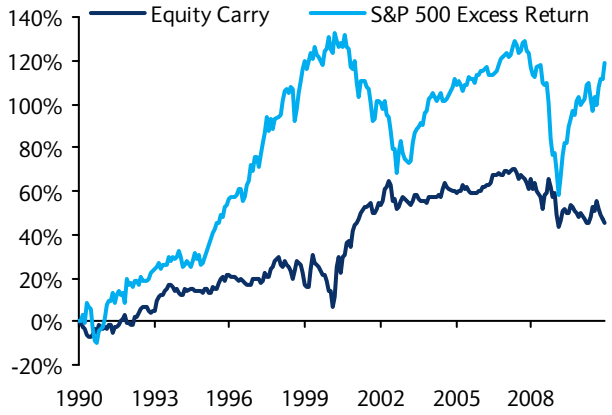
Figure 6: Assumed annual transaction costs by asset class

Equities	Rates	Currencies	Credit	Commodities	Volatility
1.00%	0.50%	0.50%	0.50%	1.00%	1.00%

Source: Barclays Capital

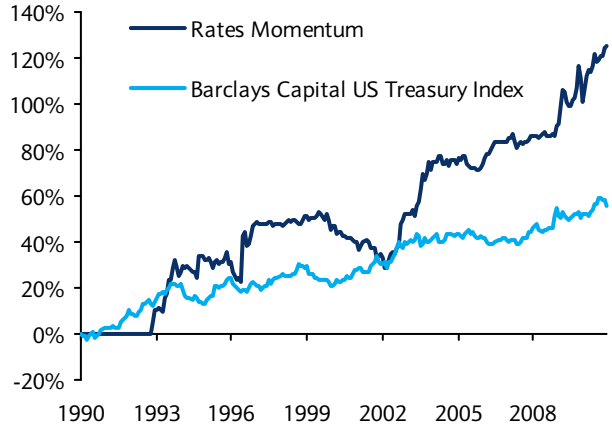
Figure 7 to Figure 10 illustrate four of the strategies in terms of cumulative excess returns. In each case, the returns are shown versus the respective traditional market beta for the asset class. The examples demonstrate the diversity in returns performance, with some strategies performing well (eg, commodities curve) and others performing more modestly (eg, equity carry). Additionally, the strategies are not highly correlated with their traditional market beta counterparts. The next section presents a more thorough empirical analysis of the full family of liquid risk premia strategies.

Figure 7: Equity carry (dividend yield)



Source: Bloomberg, Barclays Capital

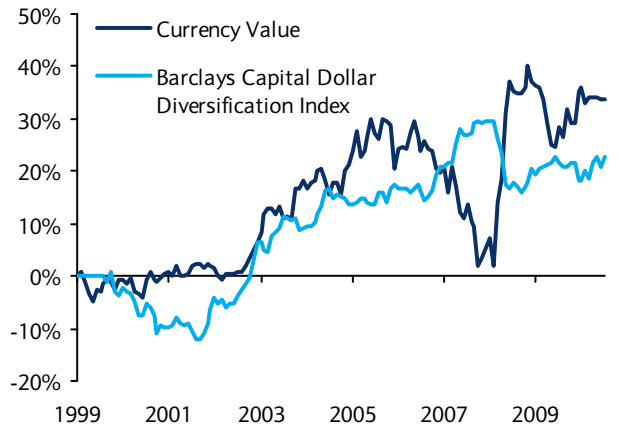
Figure 8: Rates momentum (2y, 5y, 10y, long bond futures)



Source: Bloomberg, Barclays Capital

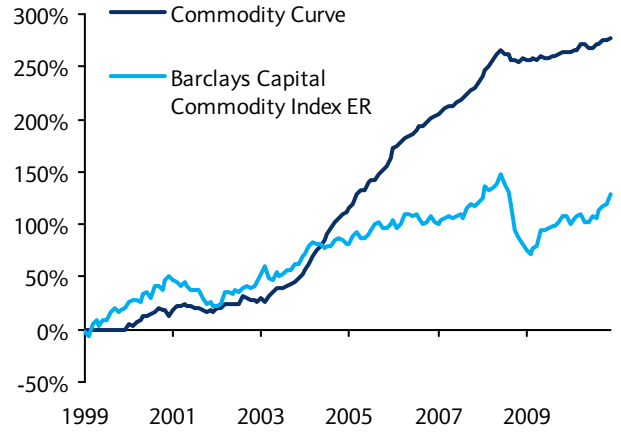
[16] For brevity, we show one cost per asset class. In a handful of cases, we use higher costs on especially high turnover strategies such as momentum.

Figure 9: Currency value (G10 deviation from PPP)



Source: Bloomberg, Barclays Capital

Figure 10: Commodities curve (3m minus nearby)



Source: Bloomberg, Barclays Capital

Properties of pure risk premia strategies

Although past performance was not a criterion for inclusion in the risk premia family, we can learn from analysing the historical characteristics. The goal of this section is not to identify the best performing strategies. At this stage, we take a "purist" perspective, which is that all these strategies should exhibit positive long-run excess returns but that past performance is not indicative of future performance. Instead, we want to focus on consistency of performance characteristics and diversification potential. Nonetheless, we start by looking at risk-adjusted returns.

Note that a full analysis of the performance of these twenty strategies is beyond the scope of this report, and the following should be considered a summary. We refer readers again to our series of reports covering individual risk premia.

Return analysis

Figure 11 shows the first of a series of tables summarising the historical performance of the family of risk premia strategies. Here, we report the average annual excess returns of each strategy and annualised Sharpe ratio, in each case indicating the start date of the available historical back-test. Recall that all the strategies are roughly (statically) scaled to 10% annual volatility. The right hand column shows, for reference, the performance of a corresponding traditional beta index. These are:

- **S&P 500 Index** (SPTR including dividends) excess return over 1m USD Libor
- **Barclays Capital US Treasury Index** excess return over 1m USD Libor
- **Barclays Capital Dollar Diversification Index** excess return – reflects the performance of a trade-weighted basket of G10 currencies versus the dollar
- **Barclays Capital US Corporate Index** excess return over duration-matched Treasuries
- **Barclays Capital Commodity Index (BCI)** excess return
- **S&P Short-Term Futures Index** inverse excess return (-1x daily), reflecting a short-volatility strategy.

Over the sample periods used, all the strategies exhibit positive returns. Sharpe ratios are generally modest, between 0.0 and 1.0, with a handful of exceptions. The most significant outlier on the upside is the commodity curve strategy. It is possible that this strategy benefited from distorted market dynamics in nearby futures during 2003-07, and these kinds of returns may not repeat. Likewise, the lowest Sharpe ratio is that of the credit curve strategy. However, this reflected a very short and turbulent period (2004-10), and ex-ante we have no reason to expect this strategy to perform any worse than any others.

Figure 11: Barclays Capital US Risk Premia Strategy Family average annual excess returns and Sharpe ratios

	Carry	Curve	Value	Momentum	Emerging Markets	Arbitrage	Traditional Beta
Equities	Dividend Yield	-	Book-to-market	Stock Mom.		Merger Arbitrage	S&P 500
Start:	Jan-90		Jan-90	Jan-90		Feb-05	Jan-90
Return:	2.1%		2.9%	3.2%		12.0%	5.3%
Sharpe:	0.2		0.3	0.3		1.1	0.3
Rates	Eurodollar	10y-2y Futures	Long-term MR	Futures Mom.	EM Money Mkts	-	BC US Treasury
Start:	Feb-90	Feb-97	Sep-90	Nov-92	Aug-01		Jan-90
Return:	11.0%	5.2%	5.6%	6.9%	7.9%		2.6%
Sharpe:	0.9	0.5	0.6	0.7	1.0		0.6
Currencies	G10 FX Carry	-	PPP Value	G10 Mom.	EM FX Carry	-	BC Dollar Bear
Start:	Feb-90		Aug-90	Mar-91	Jan-01		Feb-00
Return:	3.0%		2.6%	2.9%	12.4%		2.1%
Sharpe:	0.4		0.3	0.3	1.1		0.4
Credit	CDX HY vs, IG	10yr-5yr CDX IG	-	-	-	-	BC US Corp
Start:	Oct-05	Apr-04					Jan-90
Return:	4.4%	0.1%					0.4%
Sharpe:	0.5	0.0					0.1
Commodities	-	3M def vs nearby	Backwardation	Futures Mom.	-	-	BC Commodity
Start:		Jan-00	Feb-99	Feb-00			Jan-99
Return:		25.2%	14.6%	4.3%			10.7%
Sharpe:		2.5	1.2	0.5			0.6
Volatility	Short Vol Port	5M vs. 1M VIX				-	VIX ST Futures
Start:	Mar-00	Jan-06					Jan-06
Return:	5.2%	10.1%					27.3%
Sharpe:	0.6	1.3					0.4

Source: Barclays Capital

Dynamics of returns

Note that over shorter sample periods, performance across strategies is expected to be much more variable. In particular, we would expect certain asset classes and risk premia to be in and out of favor, in the same way as other investments. As an illustration, Figure 12 shows the cumulative excess returns over the credit crisis period, again contrasted with the respective traditional beta returns.

Analysis of the dynamics of returns on risk premia strategies could lead to more sophisticated allocation methods. Unfortunately, this is beyond the scope of this paper but will be addressed on a strategy-by-strategy level in future research.

Figure 12: Barclays Capital Liquid Risk Premia family - Summary of cumulative excess returns during the credit crisis (June 2007-March 2009).

	Carry	Curve	Value	Momentum	Emerging Markets	Arbitrage	Average	Traditional Beta (ER)
Equities	-23%		-21%	8%		15%	-5%	-49%
Rates	50%	33%	5%	28%	-10%		21%	14%
Currencies	-20%		14%	-9%	-12%		-6%	-4%
Credit	-18%	-28%					-23%	-22%
Commodities		55%	34%	3%			31%	-31%
Volatility	-16%	12%					-2%	-90%
Average	-5%	18%	8%	7%	-11%	15%		

Source: Barclays Capital

Draw-down analysis

Of course, by the nature of risk premia strategies, it is not sufficient to look at returns and volatilities to understand the risk profiles. We expect risk premia strategies to exhibit occasional, but potentially substantial, draw-downs during episodes where the risk for which the premium is sought is realized.

Figure 13 summarises the maximum draw-downs (the maximum percentage drop from peak to subsequent trough) over the full sample periods (start dates are shown in Figure 11) for the strategies and the corresponding traditional beta indices. Also shown are the months in which the trough occurred and the number of months before the strategy recovered to its peak. In some cases, the draw-down was still ongoing as of December 2010. This is indicated by the recovery time being expressed as >*N*. For example, the Dividend Yield strategy was still in a draw-down as of December 2010, and the recovery length is displayed as >23 months, indicating it is 23 months since the trough occurred (February 2009).

Again, there is a lot of information in Figure 13. Some key points are the following:

- All strategies exhibit double-digit draw-downs at some point in their histories, in most cases greater than 20% drops from peak to trough.
- The average maximum draw-down across the strategies is 21%.
- Corresponding maximum draw-downs for the traditional beta indices are variable, from just 9% on the Barclays Capital US Treasury index to 91% on the inverse S&P VIX Short-Term Futures index. Note that the strategies are all scaled to have volatilities of about 10%, whereas the traditional betas are not.
- The low points (troughs) of the strategies are generally mixed – ie, not all strategies trough at the same time. However, a number do have troughs during the credit crisis, as do the traditional beta indices. We analyse this further in Figure 14.
- Recovery from trough to the previous peak takes, on average, 14 months (excluding the four strategies that have not yet regained their peak level). This contrasts favourably

with the traditional beta indices, which all have recovery times of 20+ months (indeed, all but US Treasuries remain below their excess return peaks).

Figure 13: Maximum draw-down analysis

	Carry	Curve	Value	Momentum	Emerging Markets	Arbitrage	Traditional Beta
Equities	Dividend Yield	-	Book-to-market	Stock Mom.		Merger Arbitrage	S&P 500
Max draw-down	25%		29%	23%		16%	58%
Low date	Feb-09		Feb-00	Jan-01		Sep-08	Feb-09
Recovery time	>23		10	15		4	>23
Rates	Eurodollar	10y-2y Futures	Long-term MR	Futures Mom.	EM Money Mkts	-	BC US Treasury
Max draw-down	27%	17%	23%	22%	22%		9%
Low date	Dec-94	Jan-00	Feb-01	Mar-02	Feb-09		Jan-00
Recovery time	11	21	14	14	19		20
Currencies	G10 FX Carry	-	PPP Value	G10 Mom.	EM FX Carry	-	BC Dollar Bear
Max draw-down	30%		26%	25%	25%		13%
Low date	Jan-09		Jul-08	May-99	Feb-09		Feb-09
Recovery time	>24		4	40	19		>23
Credit	CDX HY vs, IG	10yr-5yr CDX IG	-	-	-	-	BC US Corp
Max draw-down	18%	32%					24%
Low date	Mar-09	Nov-08					Nov-08
Recovery time	9	>26					>26
Commodities	-	3M def vs nearby	Backwardation	Futures Mom.	-	-	BC Commodity
Max draw-down		11%	13%	15%			55%
Low date		Nov-08	Oct-08	Jul-10			Feb-09
Recovery time		16	6	>6			>23
Volatility	Short Vol Port	5M vs. 1M VIX				-	VIX ST Fut (-1x)
Max draw-down	30%	11%					91%
Low date	Nov-08	Oct-08					Mar-09
Recovery time	14	11					>22

Note: Table shows the maximum peak-to-trough draw-down, the month in which the trough occurred, and the number of months from the trough to recovery (flat with the peak). In cases where the draw-down is ongoing, as of December 2010, the recovery time is expressed as >N months (e.g. >23). Source: Barclays Capital

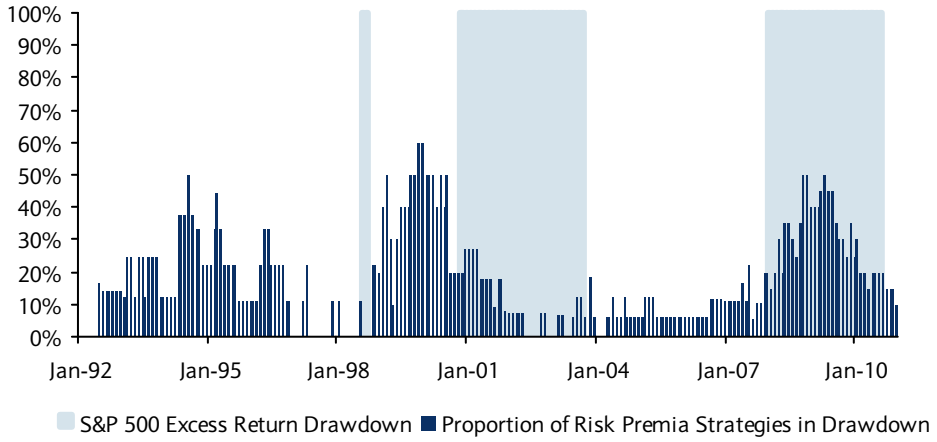
Figure 13 is based on maximum draw-downs only and does not present any information on smaller ones. Additionally, the extent of coincidence of draw-downs between strategies is not easily understood. Figure 14 presents draw-downs in a different way; it shows the proportion of the risk premia strategies in a 2-year rolling draw-down (defined as a strategy being 10% or more below its peak over the preceding two years) at each point in time. The chart also highlights the periods for which the S&P 500 excess return is in a 2-year rolling draw-down for comparison.

The first conclusion from this chart is that the overall coincidence of draw-downs across these strategies is low, but cyclical. The average proportion of strategies in a 2-year draw-down at any one time across the full period is just 18%. However, during 1999 and again during the credit crisis, the number of draw-downs rises to 40-50%. Further analysis shows

that many of the carry and curve type strategies had positive correlation with traditional beta (we will see this clearly in Figure 17 and Figure 18), which led to these two columns of strategies having draw-downs during the crisis. This explains the peak during 2008.

The peak during 1999 is harder to explain. About 50% of the risk premia strategies were in draw-downs during this period, but these were across carry, value and momentum columns, with no apparent pattern. Note that a smaller number of strategies had available data in this period (since we required a 2-year rolling window), so this peak may not be statistically significant. We note the sharp drop in number of strategies in a draw-down in early 2001. This is because the strategies whose data begin in 1999 roll into this analysis at this time and, of course, do not start out in a 10% draw-down.

Figure 14: Proportion of risk premia strategies in draw-downs at the same time' draw-downs measured as 10% or more down from the peak over last two years (rolling)



Source: Bloomberg, Barclays Capital

Correlation analysis

Having looked at individual strategy returns and risks, the last step is to look at correlation of strategies. In particular, we are interested to see whether strategies are generally highly correlated, and therefore perhaps picking up similar risk factors; whether correlations are stable, especially in crises; whether there are patterns of correlation within asset classes or risk premia type; and how the strategies correlate with respective traditional beta indices.

Figure 16 shows the complete 20x20 strategy correlation matrix, which is colour-coded to emphasise both high and low correlations. Correlations below the diagonal are computed for the maximum available pair-wise sample period between January 1990 and December 2010. Correlations above the diagonal are computed for the credit crisis period, June 2007 to March 2009. This helps us analyse the stability.

Some key points from Figure 16:

- First, the matrix is predominantly uncoloured, reflecting correlations close to zero (between -20% and 20%), both below and above the diagonal.
- Pockets of darker colours are noticeable, especially for credit, commodities and volatility, indicating high correlations.
- Equally, there are also pockets of significant negative correlations (consistent above and below the diagonal), indicating potentially diversifying strategy combinations.

- Some risk premia types show consistently low or negative correlations with other strategies – momentum is the most noticeable (which is consistent with our findings in *Liquid Momentum Strategies*, 22 February 2011).
- Overall, there is a lot of symmetry across the diagonal, indicating stability of correlation structure through the crisis.
- In particular, we do not see an "all correlations go to 1" effect during the crisis, which would have been evident by dark shading across the board in the upper triangle. The average change in correlation number, from below the diagonal to above the diagonal, is small and negative (-0.8%).

Risk premia strategies show a more stable correlation structure than traditional beta

Figure 15 contrasts the risk premia correlation patterns to traditional beta patterns. The table shows an equivalent matrix to Figure 16, but this time based on the traditional beta indices, both in the full period (below the diagonal) and in the credit crisis (above the diagonal). For example, the correlation between equity beta returns (S&P 500 index excess returns) and rates beta returns (Barclays Capital US Treasury index excess returns) is -3% over the full sample and -22% during the credit crisis period (see top left of grid). In this case we see much higher correlations across the board, except for rates (US Treasuries) and a sharper increase in correlations during the credit crisis.

In fact, excluding rates, the jump from full period correlation to crisis correlation is on average a full 14pp. The equivalent average jump for the risk premia strategies (also excluding rates strategies to make the comparison fair) is just 0.1pp.

Figure 15: Monthly correlations between traditional beta

Key:	< -50%	-50% to -20%	-20% to +20%	+20% to +50%	> +50%

	Equities	Rates	Currencies	Credit	Commodities	Volatility
Equities		-22%	66%	62%	60%	81%
Rates	-3%		-7%	-39%	-20%	-33%
Currencies	50%	10%		51%	81%	63%
Credit	47%	-27%	37%		51%	72%
Commodities	35%	-6%	56%	34%		62%
Volatility	79%	-28%	51%	68%	51%	

Note: Correlations are colour-coded. Those below the diagonal are computed for the maximum available pair-wise sample period between January 1990 and December 2010. Those above the diagonal are computed for the credit crisis period, June 2007 to March 2009. Source: Bloomberg, Barclays Capital

Figure 16: Risk premia strategies monthly correlation matrix

Key:	< -50%	-50% to -20%	-20% to +20%	+20% to +50%	> +50%

		Equities				Rates					Currencies				Cred		Comm			Vol	
		Carry	Value	Mom	Arb	Carry	Curve	Value	Mom	EM	Carry	Value	Mom	EM	Carry	Curve	Curve	Value	Mom	Carry	Curve
Equities	Carry		78%	-67%	-19%	22%	17%	-15%	-13%	12%	-11%	-9%	-31%	11%	26%	18%	-17%	-3%	-17%	-13%	-4%
	Value	70%		-77%	-20%	2%	-13%	5%	-15%	18%	9%	-7%	-36%	22%	26%	33%	-21%	9%	-17%	13%	-10%
	Mom	-37%	-35%		-5%	-25%	-12%	-5%	17%	-13%	5%	1%	42%	-9%	-8%	-20%	31%	-1%	23%	-9%	9%
	Arb	-21%	-16%	8%		23%	11%	8%	-10%	-29%	-13%	27%	28%	-25%	-22%	-15%	-15%	-21%	-20%	-13%	-27%
Rates	Carry	3%	-3%	-6%	12%		60%	0%	8%	-3%	-38%	-4%	-8%	-21%	-23%	-21%	4%	-12%	-8%	-25%	-9%
	Curve	2%	-5%	-5%	6%	71%		-57%	16%	6%	-17%	-3%	-23%	-6%	-27%	-17%	11%	11%	8%	13%	35%
	Value	-10%	-7%	-3%	9%	19%	-20%		-11%	-24%	-14%	11%	20%	-23%	-10%	-25%	-24%	-29%	-26%	-25%	-47%
	Mom	-2%	-5%	3%	-9%	0%	-3%	-3%		-6%	1%	7%	-1%	-8%	-16%	-11%	12%	8%	1%	16%	23%
	EM	24%	24%	-3%	-26%	-2%	6%	-24%	-7%		75%	-61%	-27%	84%	56%	49%	35%	18%	17%	57%	48%
Currencies	Carry	0%	4%	3%	-15%	-7%	-12%	-1%	-3%	61%		-45%	-21%	72%	40%	29%	28%	11%	7%	62%	33%
	Value	-3%	5%	5%	22%	-15%	-7%	-2%	10%	-39%	-16%		24%	-44%	-12%	-19%	-29%	-17%	-4%	-46%	-30%
	Mom	-8%	-16%	8%	25%	0%	-1%	14%	-3%	-19%	-7%	5%		-20%	-8%	-8%	-2%	-14%	8%	-30%	-15%
	EM	15%	20%	-6%	-21%	-1%	4%	-16%	-4%	81%	53%	-17%	-9%		47%	40%	15%	-3%	7%	49%	45%
Cred	Carry	26%	24%	-6%	-18%	-21%	-23%	-12%	-17%	53%	36%	-9%	-8%	46%		73%	11%	13%	23%	21%	4%
	Curve	17%	32%	-13%	-11%	-19%	-14%	-26%	-14%	47%	26%	-16%	-7%	38%	73%		5%	29%	12%	30%	2%
Comm	Curve	1%	1%	0%	4%	-26%	-3%	-26%	4%	22%	15%	-13%	-1%	4%	11%	6%		46%	34%	13%	27%
	Value	-17%	-9%	9%	-22%	-8%	8%	-17%	0%	5%	8%	-15%	-3%	-10%	13%	24%	18%		69%	33%	31%
	Mom	-20%	-20%	22%	-15%	2%	11%	-9%	-7%	8%	6%	-7%	8%	-2%	24%	12%	9%	71%		27%	28%
Vol	Carry	-6%	10%	-4%	-13%	-14%	9%	-19%	4%	50%	52%	-33%	-20%	38%	20%	30%	5%	18%	16%		56%
	Curve	-4%	-13%	2%	-29%	-2%	36%	-38%	18%	42%	32%	-21%	-10%	42%	4%	3%	15%	26%	23%	53%	

Note: Correlations are colour-coded. Those below the diagonal are computed for the maximum available pair-wise sample period between January 1990 and December 2010. Those above the diagonal are computed for the credit crisis period, June 2007 to March 2009. Source: Barclays Capital

Average correlations are generally low, by asset class and risk premia, indicating potential for diversification

Figure 16 helps give an overall sense of correlation structure and stability. The next few tables break down this structure into more digestible summaries. First, Figure 19 shows averages of correlations by asset class and risk premia. The patterns are striking. For one, correlations by asset class are close to zero for equities, rates and currencies, but high for credit, commodities and volatility. This we put down to the broader mix of strategies in the first three asset classes, compared with a small number of strategies that are more curve and carry focused for the last three. By risk premia, we find that all have low average correlations except for emerging markets, which is very high at 80%. That bucket has only two strategies, so this result is of limited significance. Nonetheless, it is reasonable to expect emerging market risk premia strategies to be driven by a common component across asset classes.

Figure 19: Average pair-wise monthly correlations, full sample periods

Average correlation across risk premia (within asset class)		Average correlations within risk premia (across asset class)	
Equities	-5%	Carry	9%
Rates	4%	Curve	7%
Currencies	1%	Value	-8%
Credit	73%	Momentum	5%
Commodities	32%	Emerging Markets	80%
Volatility	53%	Arbitrage	NA

Source: Barclays Capital

Figure 17 shows the correlations of each individual risk premia strategy with its respective traditional beta index. The table is arranged as the standard risk premia grid, and we again use the colour-coding introduced for Figure 16. Figure 18 shows the same table but over the restricted sample period of June 2007 to March 2009. Again, some clear patterns emerge. Carry and curve strategies show generally high positive correlations with the respective traditional beta indices. In many cases, these are to be expected from the simple definitions of the strategies. Value and momentum, however, show generally low or negative correlations. In both cases, the patterns are very consistent between the full sample and the credit crisis.

Although the high correlations limit the value of these strategies to some extent, we saw in Figure 11 that the Sharpe ratios of these strategies were generally higher than their traditional beta equivalents. This may indicate that the carry and curve strategies are picking up correlated, but less exploited premia.

Figure 17: Correlations (monthly) with traditional beta – Full period between January 1990 and December 2010

Key:	< -50%	-50% to -20%	-20% to +20%	+20% to +50%	> +50%

	Carry	Curve	Value	Momentum	EM	Arbitrage
Equities	5%		12%	-6%		-22%
Rates	84%	96%	-4%	2%	1%	
Currencies	39%		-38%	-13%	54%	
Credit	52%	67%				
Commodities		33%	17%	29%		
Volatility	55%	35%				

Source: Barclays Capital

Figure 18: Correlations (monthly) with traditional beta – Crisis period, June 2007 to March 2009

	Carry	Curve	Value	Momentum	EM	Arbitrage
Equities	16%		23%	-12%		-25%
Rates	74%	95%	-50%	15%	0%	
Currencies	69%		-67%	-21%	68%	
Credit	53%	67%				
Commodities		55%	17%	20%		
Volatility	57%	36%				

Source: Barclays Capital

Portfolio applications of pure risk premia strategies

Individual risk premia strategies have appealing properties, but suffer from significant draw-downs and only modestly interesting isolated risk-adjusted performance. The natural next step is to form baskets, or portfolios, of risk premia strategies. This can be done in a number of ways: by asset class, across risk premia (rows of the grid); by risk premia, across asset class (columns); or a combination of the two.

Asset-class portfolios of risk premia

We first look at asset-class portfolios of risk premia strategies – ie, portfolios formed along the rows of the risk premia grid. Figure 20 shows the summary of performance of these portfolios over the respective full sample periods.

Overall, we see reasonable improvements in characteristics versus individual risk premia strategies, as would be expected. However draw-downs are still significant across the board, and recovery periods quite lengthy. Additionally, other than for equities and rates, the portfolios experienced their troughs during the credit crisis period.

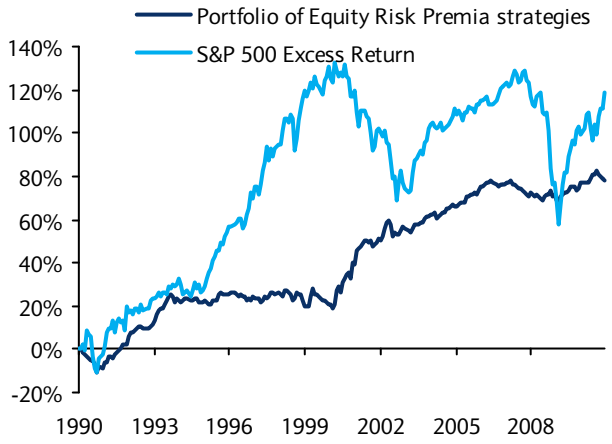
Figure 21 and Figure 22 show example historical cumulative performances for the portfolios of equity strategies and rates strategies. In each case, the cumulative returns of the respective beta indices are also shown. Immediately apparent is the variable correlation of the equity portfolio with the S&P 500 – it has clear periods of positive and negative correlations, averaging out to 2% (from Figure 20). The rates portfolio, on the other hand, is clearly positively correlated, but has a much higher rate of return and Sharpe ratio.

Figure 20: Historical performance of asset-class portfolios of risk premia (rows in the risk premia grid)

	Equities	Rates	Currencies	Credit	Commod	Volatility
Ann. Exc. Return	3.6%	8.2%	4.0%	2.1%	14.8%	6.9%
Ann. Sharpe Ratio	0.7	1.3	0.8	0.2	1.8	1.0
Correlation with traditional beta	2%	68%	19%	66%	28%	53%
Maximum draw-down	10%	11%	9%	23%	11%	19%
Month of trough	Oct-90	Dec-99	Mar-08	Mar-09	Oct-08	Oct-08
Recovery time (months)	11	20	25	21	17	13

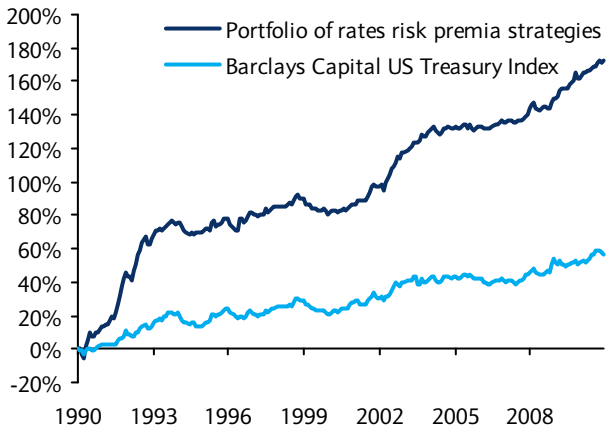
Source: Bloomberg, Barclays Capital

Figure 21: Portfolio of equity risk premia strategies – Cumulative excess returns



Source: Bloomberg, Barclays Capital

Figure 22: Portfolio of rates risk premia strategies – Cumulative excess returns



Source: Bloomberg, Barclays Capital

Portfolios of cross-asset risk premia

More interesting still is the combination of strategies of the same risk premia type, across asset classes. The correlation analysis earlier showed low correlations generally between strategies across asset classes, illustrating that there is not, for instance, a single multi-asset class "carry factor" or "momentum factor".

Figure 23 summarises the historical performance of the cross-asset class risk premia portfolios. All the characteristics show marked improvements on the individual strategies and are generally stronger than the asset-class portfolios in Figure 21. In particular, the Sharpe ratios are now becoming interesting, about 1.0 or higher. Draw-downs are 10-20%, and recovery times are shorter, generally less than a year. Finally, note that the troughs of these portfolios occurred throughout the sample period, rather than being concentrated around the credit crisis.

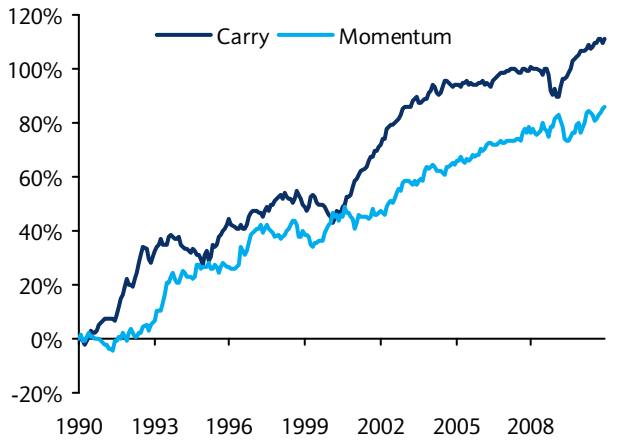
Of course, Figure 23 does not tell us anything about the correlation between these portfolios. We saw earlier that the momentum strategies in general have low or negative correlations with the other strategies. Figure 24 and Figure 25 show the cumulative excess returns of the carry portfolio and the momentum portfolio, and the value portfolio and the momentum portfolio, respectively. Their negative correlations are evident graphically.

Figure 23: Historical performance of risk-premia portfolios across asset classes (columns in the risk premia grid).

	Carry	Curve	Value	Momentum	EM	Arbitrage
Ann. Exc. Return	5.2%	9.8%	4.7%	4.0%	10.3%	12.0%
Ann. Sharpe Ratio	1.0	1.5	0.9	0.7	1.1	1.1
Maximum draw-down	11%	16%	14%	10%	23%	16%
Month of trough	Feb-00	Dec-99	Oct-90	Jul-09	Feb-09	Sep-08
Recovery time (months)	10	14	10	9	19	4

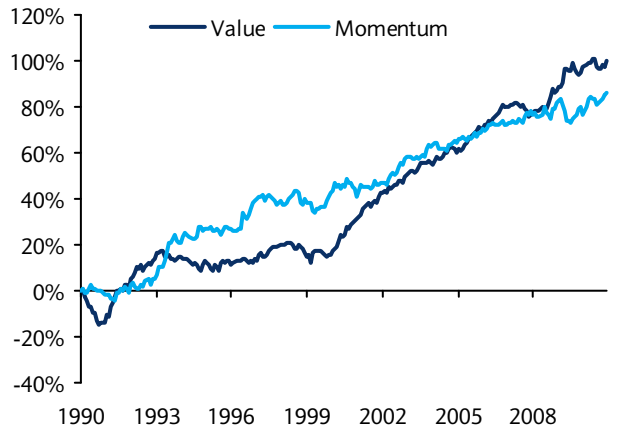
Source: Bloomberg, Barclays Capital

Figure 24: Cross-asset class portfolios of carry and momentum risk premia – Cumulative excess returns



Source: Bloomberg, Barclays Capital

Figure 25: Cross-asset class portfolios of value and momentum risk premia – Cumulative excess returns



Source: Bloomberg, Barclays Capital

Combining risk premia portfolios

These observations lead to the third category of portfolios, combining risk premia types. The possibilities and potential are significant, and we focus on just one example in this report. Motivated by Figure 24, and by the generally accepted complementary nature of carry and momentum, we look at a simple 50/50 combined portfolio. Figure 26 reports corresponding results for this portfolio, compared with the individual portfolios from above. As expected, the negative correlation leads to a higher Sharpe ratio and smaller draw-down (the recovery time is longer but this is misleading in this case, as the maximum draw-down occurs at a different time in each of the three portfolios, so the recovery times are not comparable).

Figure 26: Combining carry and momentum

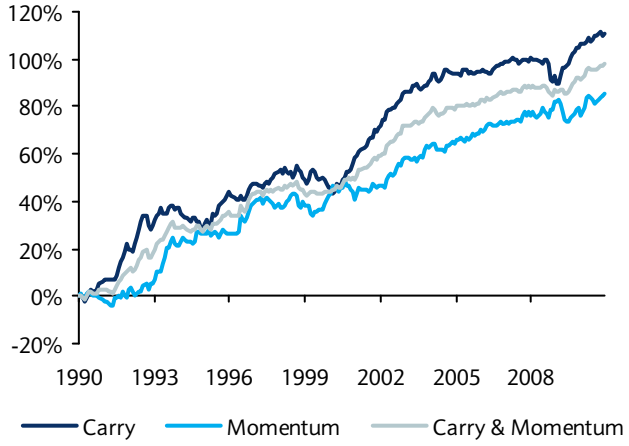
	Carry	Momentum	Carry & Momentum combined
Ann. Exc. Return	5.2%	4.0%	4.6%
Ann. Sharpe Ratio	1.0	0.7	1.3
Maximum draw-down	11%	10%	6%
Month of trough	Feb-00	Jul-09	Feb-99
Recovery time (months)	10	9	18

Source: Barclays Capital

Figure 27 shows the cumulative returns of the combined portfolio, together with the two separate portfolios. The improved Sharpe ratio is evident, as the combined portfolio exhibits much lower volatility thanks to the complementary returns of the two components.

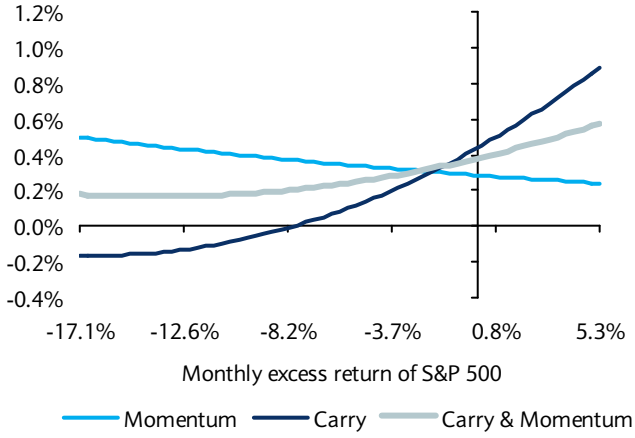
Lastly, Figure 28 shows the payoff profiles of these portfolios versus the S&P 500. Specifically it shows (fitted) lines representing the monthly average returns of the three portfolios in different buckets of S&P 500 monthly excess returns. For example, historically, in months when the S&P was down 5%, the carry portfolio had an average return of about 0.1%. The momentum portfolio had an average return of about 0.4%, and the combined carry and momentum somewhere in between. The chart illustrates the fact that the momentum strategy is generally positive on average but does slightly better when the S&P 500 is underperforming. The carry strategy, on the other hand, does better when the S&P 500 is outperforming. The combined portfolio, therefore, has a somewhat flatter overall profile.

Figure 27: Carry and momentum combined – Cumulative excess returns



Source: Bloomberg, Barclays Capital

Figure 28: Average monthly fitted historical payoff profiles, versus S&P 500 monthly excess returns



Source: Bloomberg, Barclays Capital

Broad portfolios – "funds" of risk premia

Continuing the thought process so far, we find many possibilities for diversified portfolios of risk premia. An increasingly popular concept is the formation of broad diversified portfolios (or "funds") or risk premia as alternative asset allocation solutions[17] As a simple example, we use all twenty individual strategies, equally weighted. We analyse this diversified portfolio of risk premia in the context of an overlay on a traditional beta portfolio.[18]

Figure 22 reports the performance of the Diversified Risk Premia (DRP) portfolio. It also shows the performance of the traditional beta portfolio on its own, and with a 20% weight unfunded overlay of the DRP portfolio, which has reasonably strong performance over the sample period, with a Sharpe ratio of 1.85 and maximum draw-down of just 7.6%. These numbers are roughly in line with the progression in performance from the previous examples, where in each case the portfolios benefit progressively from more and more diversification.

The traditional portfolio over this twenty-year history has an average annual excess return of 4.3% and a Sharpe ratio of 0.52. The draw-down is significant, driven by the equity component, at 30.9%, and is ongoing still as of December 2010 (indicated by the recovery time being 23 months and counting). Adding the 20% unfunded DRP overlay has the expected effects. The average excess return increases nearly a full percentage point, to 5.1%, giving a new Sharpe ratio of 0.61. This is a substantial improvement, given the size of the overlay. The draw-down is marginally reduced to 30.0%. Finally, the recovery from the draw-down is complete in this case, having lasted 22 months in total (re-attaining peak levels by November 2010).

As we discuss below, this equally weighted DRP portfolio is by no means an optimal portfolio in any sense, but serves as a simple example of the concept.

[17] See *Alternative Investment Allocations: The role of indices*, July 12, 2010.
[18] This is formed as 50% S&P 500 index, 35% Barclays Capital US Treasury index, 10% Barclays Capital US Credit Index and 5% Barclays Capital Commodity index.

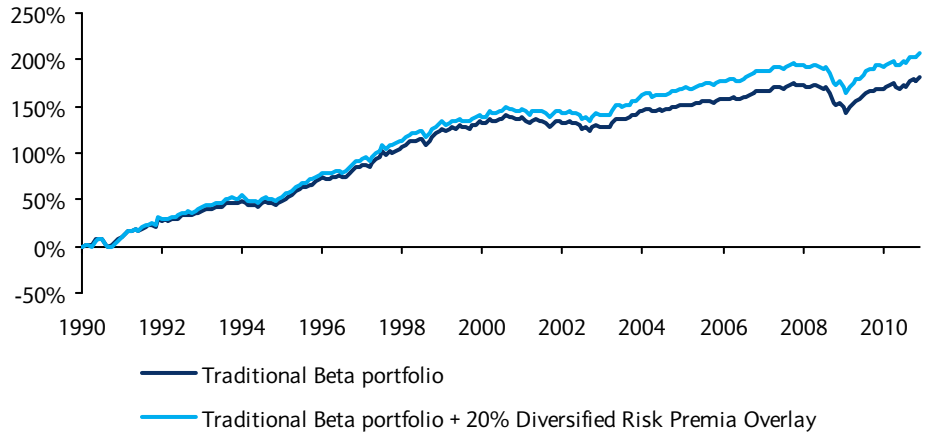
Figure 29: Diversified Risk Premia portfolio – Historical performance (January 1990 – December 2010)

	Diversified Risk Premia (DRP)	Traditional Beta Portfolio	Traditional Beta Portfolio + 20% DRP Overlay
Ann. Exc. Return	6.1%	4.3%	5.1%
Ann. Volatility	3.3%	8.4%	8.4%
Ann. Sharpe Ratio	1.85	0.52	0.61
Maximum draw-down	7.6%	30.9%	30.0%
Month of trough	Dec-99	Feb-09	Feb-09
Recovery time (months)	8	>23	22

Source: Barclays Capital

Figure 30, finally, shows the cumulative total returns of the portfolio with and without the DRP overlay.

Figure 30: Adding an unfunded diversified risk premia overlay to a traditional beta portfolio – Cumulative total returns



Source: Bloomberg, Barclays Capital

Dynamic portfolios

There is great potential or optimizing broad portfolios of risk premia – a topic for future research

So far, all the steps have been natural progressions that do not use historical performance to motivate any of the constructions. In forming portfolios, we have not tried to select, for instance, the best performing risk premia, or the least correlated, or those with the lowest draw-downs. This is all to maintain the out-of-sample nature of the analysis. Of course, careful use of empirical results may be justifiable. For instance, optimized portfolios of risk premia, using the reasonably stable correlation structures, may be appealing, as would be careful selection processes for identifying the most promising strategies at each point in time. We leave the details of such approaches to future research. However, in the next and final section, we show how individual strategies can be enhanced and even timed, and provide a selection of live tradable examples in the Barclays Capital Strategy Index family.

Enhanced risk premia strategies and Barclays Capital Indices

Simple modifications can lead to enhanced risk premia strategies

The pure risk premia strategies introduced intentionally use the simplest possible constructions to avoid any backward-looking bias in their performance histories, as well as

to provide the most robust constructs. However, in many cases, there can be economically justifiable modifications to the strategy implementation to produce enhanced versions with improved characteristics.

"Risk-averse" timing of risk premia can potentially be effective, but are difficult to calibrate

Further, the ultimate goal for individual strategies is to be able to "time" the exposure to risk premia. In general, a long exposure to risk premia is desirable, for the reasons outlined throughout this report. However, if there is a mechanism to reduce exposure, or even go short, ahead of draw-downs, performance would clearly be dramatically improved. Of course finding such a mechanism is notoriously difficult, and there are only a few historical periods on which to test it. However, risk-averse mechanisms – that is, mechanisms that switch off risk premia at any hint of trouble, accepting that this may cost some upside – can make sense and be calibrated independently of historical episodes.

As an example, Figure 31 shows the cumulative excess returns of three strategies:

i. the pure FX carry strategy (as used in the risk premia family above);

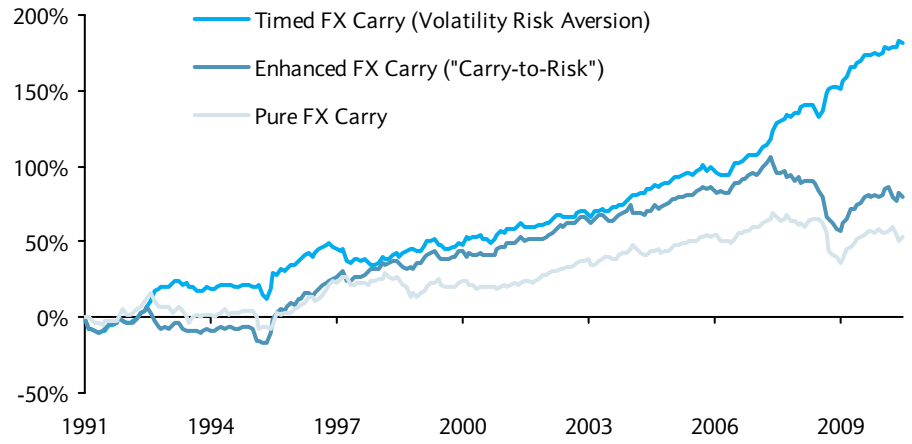
ii. an enhanced FX carry strategy, which uses as its selection criteria the yield divided by volatility rather than simply the yield; and

iii. a timed FX carry strategy that defaults to being long the enhanced FX carry strategy but can switch to being short when implied volatility across FX markets is deemed to be rising.

These three strategies were introduced and extensively analysed in *The G10 FX Carry Premium*, November 24 2010.

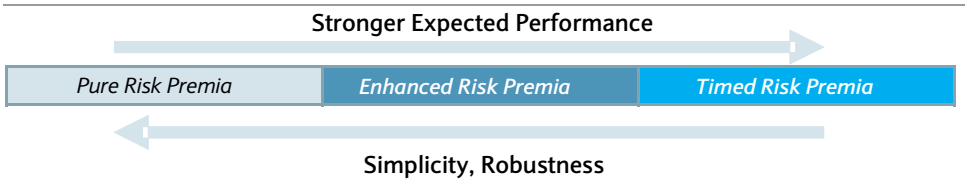
The examples illustrate the potential. The pure risk premium strategy serves as a benchmark for the enhanced and timed risk premium strategies to beat. In this case, the hypothetical historical test does indeed show improved returns (and Sharpe ratios, although we do not report these in the chart). However, this improved hypothetical performance naturally comes at the cost of simplicity and robustness, inevitably building in some level of backward-looking information. This is unavoidable, but the resulting model-risk can be managed by avoiding excessive testing and monitoring parameter stability. Figure 32 summarises this trade-off.

Figure 31: Example pure, enhanced and timed FX carry – Cumulative excess returns



Source: Bloomberg, Barclays Capital

Figure 32: The trade-off between sophistication and robustness



Source: Bloomberg, Barclays Capital

Barclays Capital Tradable Strategy Indices

Barclays Capital Strategy Indices can be considered in the risk premia structure

Barclays Capital research publishes a large range of strategy indices[19] These are directly tradable through index-linked products. The family of strategies covers all asset classes and includes many well-known strategy types and styles, from beta to enhanced beta to alpha.

This supports the claim that risk premia are the building blocks of active strategies

The family of strategy indices presents a convenient test for the risk premia taxonomy framework that we have described. The indices were, in general, not developed with this risk premia grid in mind. Despite this, we find that a large number of indices can be categorised clearly as pure, enhanced or timed risk premia. Figure 33 shows the risk premia grid once more, but this time populated with such examples, colour-coded to represent the pure, enhanced and timed varieties.

Portfolios of strategy indices should be diversified across asset classes and risk premia

This understanding also helps bring structure to the family of indices and allows for more powerful decision-making on forming portfolios of active strategies. As we have seen, portfolios will benefit from diversifying across asset classes and risk premia. For instance, the complementary effects of carry strategies and momentum strategies or value strategies and momentum strategies can be exploited in the selection process.

Figure 33: Barclays Capital Strategy Indices as tradable implementations of pure, enhanced and timed risk premia

Key:	*Not currently available*	*Pure*	*Enhanced*	*Timed*

	Carry	Curve	Value	Momentum	EM	Arbitrage
Equities	-	-	Q-True Value Q-BES[1]	Q-GSP[1]	Advanced EM	Q-MA
Rates	Exceed Family	TrendStar+	Targeted Exposure Value[2]	Targeted Exposure Momentum[2]	GEMS Dynamic GEMS	-
Currencies	Intelligent Carry Index (ICI)	-	Value Convergence	EM FX Momentum[3] Adaptive Trend	EM FX Carry[3]	-
Commods	-	Roll Yield	Backwardation	ComBATS 6 Voyager	-	-
Volatility	Enhanced BuyWrite[3]	Q-VOLTAS	-	-	-	-

Note: 1) Q-BES and Q-GSP have value and momentum features, respectively, in their construction but use other selection factors (including earnings surprise and earnings growth, respectively).

2) The Targeted Exposure Futures family of indices is available individually (2y, 5y, 10y and long bond) and can be used to easily construct the simple value and simple momentum strategies described. The full family of Targeted Exposure Futures indices is directly tradable via the respective iPath® exchange-traded notes.

3) EM FX Momentum, EM FX Carry and Enhanced Buy-Write strategies are in the process of being converted to official Barclays Capital Indices, but are currently available only as custom strategies.

Source: Barclays Capital

[19] See *Barclays Capital Indices*, February 4, 2011.

Conclusions

Pure risk premia strategies combine appealing long-run performance with identifiable risk profiles and stable characteristics. They constitute the underlying sources of returns of many active strategies. The Barclays Capital Risk Premia framework is a systematic approach to identifying and understanding risk premia strategies across asset classes.

The framework can be used to design portfolios of strategies. Portfolios of risk premia have superior risk-reward characteristics to individual strategies, benefiting from diversification across asset classes and/or across risk premium type. Applications are numerous, as both total return solutions and portfolio overlays.

Finally, pure risk premia strategies can be enhanced or even timed, using discretionary or rules-based approaches. Enhanced and timed risk premia offer the further potential to improve performance, but at the cost of simplicity and, possibly, robustness.

The Barclays Capital Strategy index family offers tradable solutions for forming custom portfolios of pure, enhanced and timed risk premia.

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