Currency hedging momentum strategies

Research Report

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Executive summary

Through previous work we have established that all versions of momentum strategy that we are implementing are derived from two core forms of portfolio insurance strategy: risk-based portfolio insurance (RBPI) which is a generalised form of constant-proportion portfolio insurance (CPPI) where the multiplier varies as a function of an estimate of risk; and options-based portfolio insurance (OBPI) which is based on delta-hedging based replication of an option.

Theory suggests that these two core forms of portfolio insurance strategy should be very similar and that any differences are simply a matter of configuration. The same goes for their application as momentum strategies, which is what this research report is concerned with. To empirically verify this assumption and establish a naïve reference, we have defined a base case for each form of momentum strategy. In addition we define a simple moving average model as a naïve comparator.

We have then undertaken a careful analysis of our momentum models, starting from the base case "climbing the ladder of innovations" up to the live case, which is our "enhanced" version of the base case, including several additional "features" that are currently running client money. In the process we have considered and evaluated the impact of each individual feature, with the purpose of extensively comparing our momentum models.

Our simulations of each momentum strategy and its associated features cover 21 currency pairs in the set derived from the major 7 currencies: AUD, CAD, CHF, EUR, GBP, JPY, USD. Together these currency pairs account for over 80% of global FX turnover and almost all of our overlay assets under management. We run these simulations over the period 1990 to 2015, which gives us 25 years of historical data to work with and present results weighted both by MSCI World tracking baskets and equally weighted in a cross-hedging application. In addition, we have adopted a transparent approach to the simulations in that they were all executed in an easily accessible Excel spreadsheet and we have made each simulation configuration and associated results available for any interested reader to review.

The results of this analysis suggest that, for the purposes of achieving the return and payoff properties associated with a momentum strategy both momentum models are essentially equivalent. Whilst differences between the candidate momentum strategies are time-varying and vary by currency pair, in the grand scheme of things and in aggregate they are marginal, both with respect to each other and with respect to the base case.

We're left with no obvious way to objectively choose between either form of momentum strategy. Any decision about which momentum strategy to adopt is ultimately going to have to be a subjective assessment that considers qualitative factors like: relative parsimony; modularity; generality; the dollar value of assets overlaid; client sensitivity; or ease of implementation. A subjective assessment like that is beyond the scope of this report and needs to involve all stakeholders. Our recommendation is therefore that all stakeholders score each strategy based on the list of categories above and arrive at a decision by considering the consensus scores for each of these categories in conjunction with the results contained in this report.

What we can conclude is that deciding precisely which momentum strategy to bet on at any point in time is difficult to do and offers a low marginal return to effort. Perhaps it is enough to simply define the momentum process in a well-reasoned, theoretically sound fashion that doesn't require extensive analysis and be done.

Contents

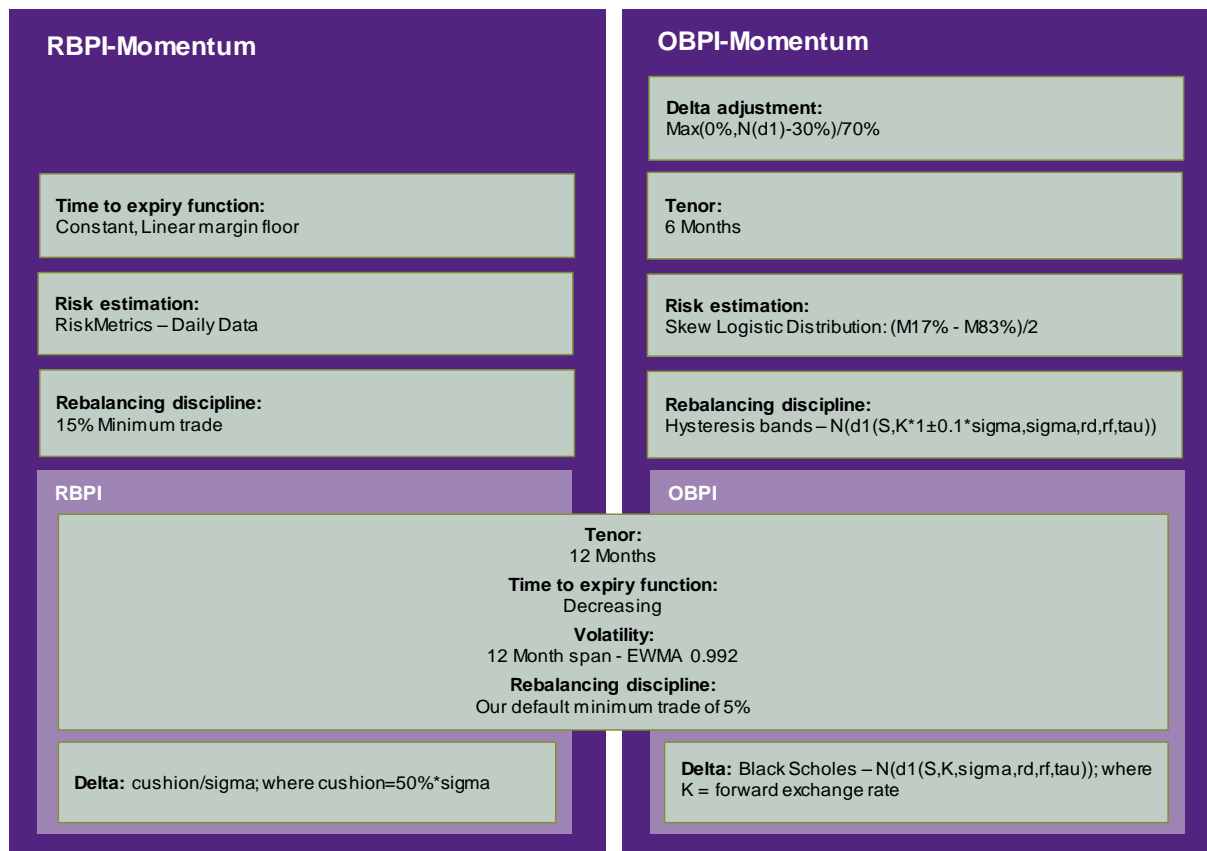# 1 Background and description of existing momentum strategies

Through previous work we have established that all versions of momentum strategy that we are implementing are derived from two core forms of portfolio insurance strategy: risk-based portfolio insurance (RBPI) which is a generalised form of constant-proportion portfolio insurance (CPPI) where the multiplier varies as a function of an estimate of risk; and options-based portfolio insurance (OBPI) which is based on delta-hedging based replication of an option.

The most widely applied version of OBPI is that implemented for our North American and UK clients. The most widely applied version of RBPI is that implemented as the portfolio insurance process (constraints) in all non-Japanese accounts and the version implemented for Australian accounts for the portfolio insurance process (constraints) and the momentum factor. There are also several other side versions of RBPI implemented for UK accounts, in a long-short combination and for Japanese accounts we implement a combination of OBPI and a version of RBPI (legacy CRM).

This report concerns the application of the two core forms of portfolio insurance strategy as proxies for the currency momentum factor i.e. they have only an indirect role in ensuring client-specific risk limits are respected. We are not considering them in their direct portfolio insurance application where the objective is to guarantee a maximum loss relative to some risk free position i.e. the constraints layer in our modular models platform. This was addressed in the 2014 paper titled "The Risk-Based Portfolio Insurance Factor". In fact, our choice of whether to implement a CPPI style of portfolio insurance is independent of any analysis. If there is a pre-agreed maximum loss associated with the overlay then the choice between delta-hedging replication and a CPPI style process is largely out of our hands – only a CPPI style process aims to guarantee some minimum value of the portfolio.

For the purposes of this analysis let us call the RBPI-based momentum strategy implemented for Australian accounts RBPI-Momentum to distinguish it from the core, more standard form of RBPI. Similarly we shall call the OBPI-based momentum strategy implemented for our North American accounts, OBPI-Momentum to distinguish it from the core standard form of OBPI. A detailed description of each strategy follows below:

Figure 1 – Composition of each momentum strategy and scope the analysis

RBPI-Momentum

Time to expiry function:
Constant, Linear margin floor

Risk estimation:
RiskMetrics – Daily Data

Rebalancing discipline:
15% Minimum trade

RBPI

Delta: cushion/sigma; where cushion=50%*sigma

OBPI-Momentum

Delta adjustment:
Max(0%,N(d1)-30%)/70%

Tenor:
6 Months

Risk estimation:
Skew Logistic Distribution: (M17% - M83%)/2

Rebalancing discipline:
Hysteresis bands – N(d1(S,K*1±0.1*sigma,sigma,rd,rf,tau))

OBPI

Tenor:
12 Months
Time to expiry function:
Decreasing
Volatility:
12 Month span - EWMA 0.992
Rebalancing discipline:
Our default minimum trade of 5%

Delta: Black Scholes – N(d1(S,K,sigma,rd,rf,tau)); where K = forward exchange rate

This analysis begins with the core base strategies we have defined for both, labelled as RBPI and OBPI, in the diagram shown in Figure 1 above. We then assess the impact of each feature, by adding it to the base case and contrasting the outcome to that associated with the base case. Finally, we produce results for the momentum strategies with all the additional features listed above as they are running in the live environment with client money.

Reference to the base cases, RBPI and OBPI in Figure 1, is made in the theoretical review following this section. A thorough description of RBPI and OBPI is outside the scope of this report since this has been covered in previous research and we can refer to a wealth of academic literature that is available for this. For the remainder of this section we therefore focus on a description of the features peculiar to each momentum strategy as shown in Figure 1:

1.1 RBPI-Momentum

Rebalancing discipline:

A fixed minimum trade style turnover constraint of 15% is applied to the hedge ratio of the RBPI-Momentum model. This feature is not specific to momentum, it is the rebalancing discipline applied to the net position of our FNA strategy but the momentum strategy would be subject to it if it were the only factor running in this configuration.

This feature functions as follows:

$$\begin{cases} if \ (Exp_{Ideal,t} - Exp_{Ideal,t-1}) < drift \ band \ \rightarrow \ Exp_{Target,t} = Exp_{Target,t-1} \\ \qquad otherwise \qquad\qquad\qquad\qquad\quad Exp_{Target,t} = Exp_{Ideal,t} \end{cases}$$

Where:

$Exp_{Ideal,t}$ represents the exposure at time t of the unconstrained model (without drift bands);

$Exp_{Target,t}$ represents the exposure at time t of the constrained model (with drift bands);

This minimum trade constraint is applied to the net trade at implementation.

Risk estimation:

The RBPI-Momentum model as implemented in the live environment uses an exponentially weighted moving average with a λ factor equal to 0.94 and with a daily risk estimation window (as documented in the Risk Metrics papers). This is expressed in the formula below:

$$\sigma_{1,t+1|t}^2 = \lambda\sigma_{1,t|t-1}^2 + (1-\lambda)r_{1,t}^2$$

We can derive the period t + 1 variance forecast, given data available at time t (one day earlier). The subscript "t + 1|t" is read "the time t + 1 forecast given information up to and including time t." The subscript "t|t − 1" is read in a similar fashion.

Time to expiry function:

The time to expiry function for the RBPI-Momentum we define to consist of two time features, a constant tenor for the RBPI function and a common portfolio insurance feature called a "margin floor" which is analogous to spending some proportion of your total option budget as a function of time.

1. Constant tenor

The RBPI-Momentum uses a time to expiry function that assumes a constant tenor of the strategy. RBPI is defined to have the time to expiry function scale the risk estimation that goes into the denominator of the multiplier calculation; if time to expiry is decreasing it can affect the multiplier quite drastically. Figure 2 below shows the RBPI multiplier for a standard decreasing time to expiry function (used in the base case) and the constant time to expiry function. The standard time to expiry function causes the multiplier to grow exponentially as the expiry approaches. Under standard time to expiry, the strategy becomes much more risk averse as it approaches the end of its tenor.

Figure 2: multiplier example for base RBPI strategy on AUDUSD with 12 months tenor and 260 day risk horizon
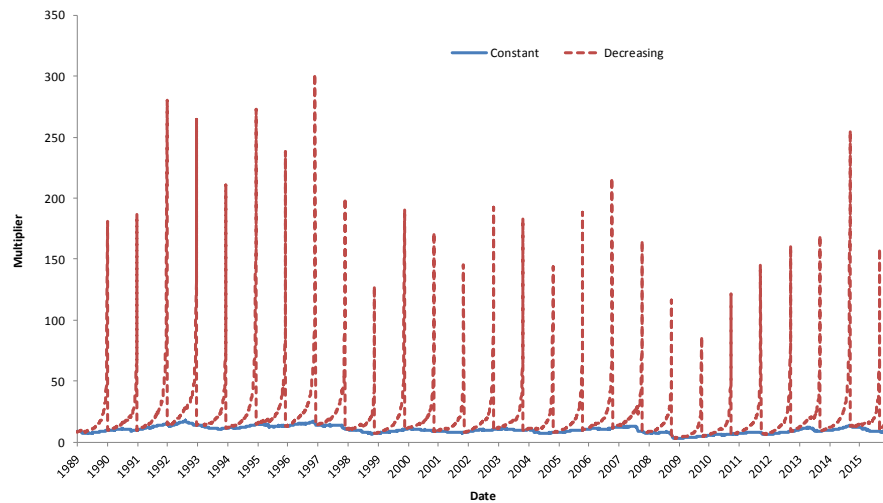
A constant tenor makes sense for a strategy designed to operate in perpetuity. It is also especially applicable to the naïve RBPI we use as the proxy for a momentum strategy (RBPI-Momentum) here as this has been defined to scale according to daily risk as per its portfolio insurance application defined in the 2014 paper "The Risk-Based Portfolio Insurance Factor". What's more, from a "risk premium" point of view, it's not obvious why one would want a momentum model that reacts to a trend with an intensity that is dominated by a decreasing function of time.

2. Margin floor

The "margin floor" feature spreads the allocation of the portfolio insurance "cushion" through time. This feature is analogous to spending some proportion of a total budget available for the purchase of options according to some function of time. This affects the value of the floor as illustrated in the formula here below:

$$f(t) = \begin{cases} V_0 - C_{50,inc} - C_{100,inc} * \left(1 - \dfrac{DaysToExp}{HorizonPeriod}\right) & MF = 1 \\ V_0 - C_{50,inc} & MF = 0 \end{cases}$$

Where:

- V_0 represents the value of the portfolio at time 0, which is equals to 100;

- $C_{50,inc}$ and $C_{100,inc}$ represents the value of the cushion at the beginning of the horizon period;

- $DaysToExp$ is the number of days to end of the performance horizon;

- $HorizonPeriod$ which in the live case is 12 months;

- $MF \in [0, 1]$ is a binary flag that indicates when the margin floor feature is active or not;

The meaning of this formula is that value of the floor linearly decreases to maturity starting from $V_0 - C_{50,inc}$ and approaching $V_0 - C_{50,inc} - C_{100,inc}$ at the end of the horizon period. A graphical example of this is provided in Figure 3 below.

Figure 3: Margin floor example for a generic RBPI strategy on AUDCAD with 12 months tenor[1]
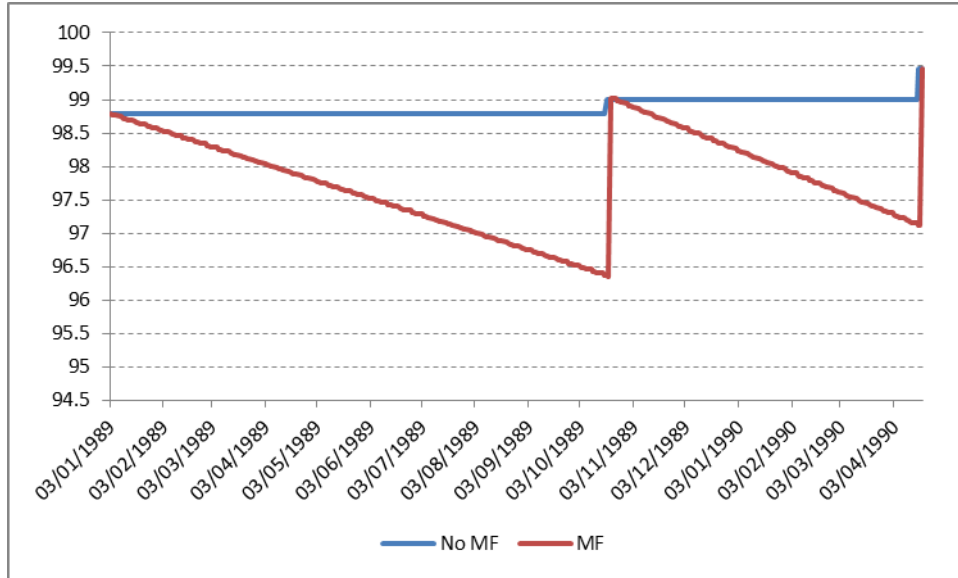
1.2   OBPI-Momentum

Rebalancing discipline:

Hysteresis bands are a sophisticated form of rebalancing discipline, which draw their names from the hysteresis loop, in physics, because of their particular shapes.

OBPI ideal signal exposure and the hysteresis bands are derived using the Black-Scholes delta function and adjusting the strike. The hysteresis bands are symmetrically calculated around the ideal exposure, stressing the strike by +/- 0.1σ.

$$\Delta_{Call} = N(d_1) * e^{-r_d * \left[\frac{Option\ tenor}{12} - (T-t)\right]}$$

$$\Delta_{Put} = (N(d_1) - 1) * e^{-r_d * \left[\frac{Option\ tenor}{12} - (T-t)\right]}$$

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[1] MF stands for margin floor

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Where:

$$d_1 = \frac{\left(\ln\left(\frac{S}{K}\right) + \left(r_b - r_d + \frac{\sigma^2 * \left[\frac{Option\ tenor}{12} - (T-t)\right]}{2}\right)\right)}{\left(\sigma * \sqrt{\left[\frac{Option\ tenor}{12} - (T-t)\right]}\right)}{}^2$$

Figure 4: Hysteresis bands on a call option
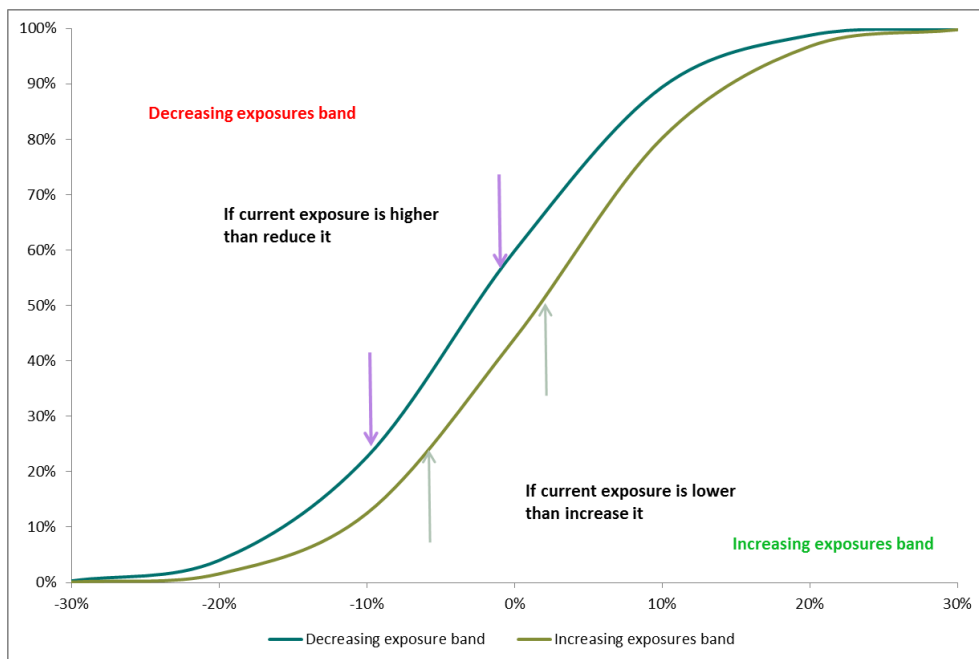
The band with the higher volatility is called "increasing exposure band" and vice-versa. The way this mechanism works is such that, every time the ideal target exposure updated at present time is equal or exceeds the hysteresis bands, the model trades up or down to the next ideal target exposure level, following the loop pictured in figure 3. An interesting feature of this type of trading bands is that they react to volatility, in particular they tend to widen when the volatility increases and vice versa. This feature can be highly desirable to avoid some unprofitable turnover.

$$\begin{cases} if\ Exp_{Target,t} > Exp_{Dec,t} \rightarrow Exp_{Dec,t} \\ if\ Exp_{Target,t} < Exp_{Inc,t} \rightarrow Exp_{Inc,t} \\ otherwise \qquad\qquad Exp_{Target,t} = Exp_{Target,t-1} \end{cases}$$

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[2] Hysteresis bands are calculated using the same Black Scholes functional form but with different volatility estimate appropriately calculated

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Where:

$Exp_{Ideal,t}$ represents the exposure at time t of the unconstrained model (without drift bands);

$Exp_{Target,t}$ represents the exposure at time t of the constrained model (with drift bands);

$Exp_{Dec,t}$ represents the exposure at time t as indicated by the decreasing exposure band;

$Exp_{Inc,t}$ represents the exposure at time t as indicated by the increasing exposure band;

This rebalancing discipline is clearly specific to the signal it is operating on. Theory suggests that a rebalancing discipline, whether that would be a minimum trade or some other form of trading band, should only serve to lower turnover. There should be no market timing edge. Therefore it's hard to justify having a trading band built into the signal like this unless the entire overlay is just the momentum signal. This limits its application in a multi-factor strategy context, meaning other more traditional turnover constraints would be required in addition to this.

Risk estimation:

OBPI uses the skew logistic distribution described in detail below.

Consider the standard logistic distribution specified by the cdf:

$$H(x) = \frac{1}{1 + e^{-x}}, \quad -\infty < x < \infty$$

and the pdf :

$$h(x) = \frac{e^{-x}}{(1 + e^{-x})^2}, \quad -\infty < x < \infty$$

The pdf of the usual skew logistic distribution is given by

$$f_{SL}(x; \lambda) = 2h(x)H(x) = \frac{2e^{-x}}{(1 + e^{-x})^2(1 + e^{-\lambda x})}$$

Assuming that the spot return follows a skew logistic distribution, the yearly volatility can be calculated as follows:

$$\sigma_{SL} = \left(\frac{F_{SL,83}^{-1} - F_{SL,17}^{-1}}{2}\right) * SF$$

Where:

- $F_{SL,83}^{-1}$ represents the inverse of cumulative distribution function of the skew logistic calculated at 83% of probability;

- SF is the yearly scaling factor which is equal to $\sqrt{\frac{260}{10}}$[3];

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[3] The skew logistic estimate is calculated on yearly horizon of 260 working days with a 10 day holding period

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Tenor:

This feature simply represents the choice of option tenor in the OBPI replicating portfolio. In theory the OBPI-Momentum strategy has 6 months and 12 months as potential configurations for tenor. Currently all the live OBPI-Momentum signals are using an OBPI type of signal with 6 months tenor and therefore when we compare the live strategies, we assume 6 months to be the established feature of the OBPI-Momentum strategy.

Delta adjustment:

Notional minimal exposure is simply a mechanism to ensure that the model will be quicker to cut the exposure back to benchmark in case of a reversal and it won't hold residual exposure in case of a lack of a trend.

The mechanism in itself is very simple: it assumes a static level of target exposure, called NME, and if the option delta is lower than this, then the exposure will be cut 0, otherwise will be scaled up to the remaining range.

Illustrating this with a formula, this will be:

$$\Delta_{Call,NME} = \frac{\max(\Delta_{Call} - NME, 0)}{(1 - NME)}$$

$$\Delta_{Put,NME} = \frac{\min(\Delta_{Put} + NME, 0)}{(1 - NME)}$$

The NME parameter used in OBPI signal is 30%.

2   Theoretical review

In the research report titled "The Risk-Based Portfolio Insurance Factor" – June 2014, it was shown that OBPI or delta-hedging can be interpreted as a generalised form of CPPI where the multiplier is defined as follows:

$$m_t^{OBPI} = \frac{S_t \mathcal{N}(d_1(t,S_t))}{C(t,S_t,K)}$$

Where t is time, m_t is the multiplier, S_t is the exchange rate, $\mathcal{N}(d_1(t,S_t))$ is the Black-Scholes delta and $C(t,S_t,K)$ is the Black-Scholes option cost. This solves for the multiplier implied by the option delta given its cost. This option cost is analogous to the cushion in CPPI. Preserving this OBPI based multiplier, it is clear to see that by adding a pre-determined loss limit through a CPPI style cushion gives the following:

$$m_t^{OBPI} = \frac{S_t \mathcal{N}(d_1(t,S_t)) C_t^{CPPI}}{C(t,S_t,K)^2}$$

Where C_t^{CPPI} represents the surplus or cushion applied to the OBPI process. As stated in the 2014 paper, it is the hedging volatility used and the loss limit (or lack thereof) that are the biggest determinants of hedging outcome. It should be expected that once one introduces the concept of a CPPI cushion to an OBPI strategy the outcome is very similar to a CPPI style strategy like risk-based portfolio insurance (RBPI). This is evident in Figure 5, drawn from the 2014 paper, which the difference in hedge ratio and 50% hedged benchmark-relative return for an AUD/USD call between delta-hedging and RBPI where a pre-determined loss limit of 3% has been set.

Figure 5 – Difference in hedge ratio and cumulative value added by OBPI and RBPI for AUD/USD for 3% floor (2014 paper)
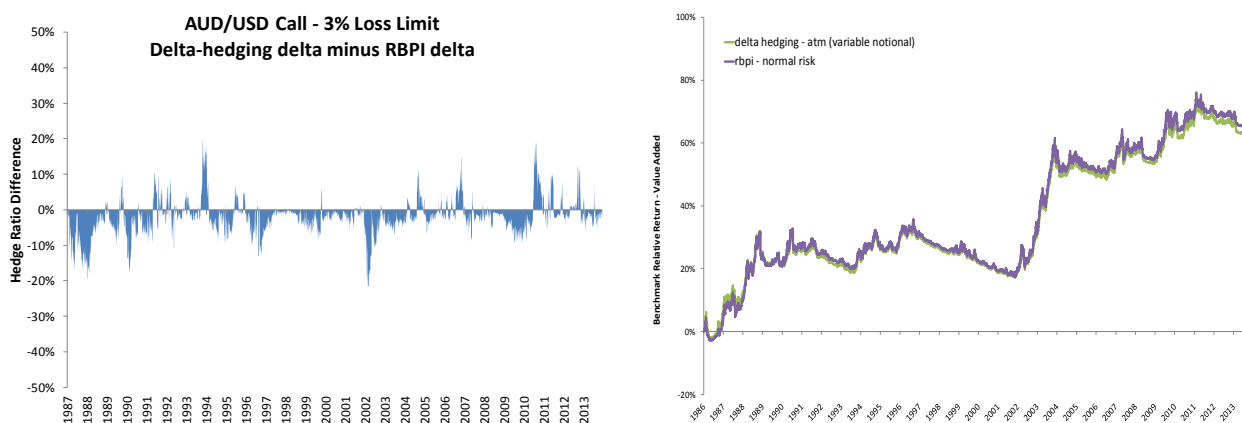
Similarly, we should expect that if we define the "risk-free" position for both to be 50% hedged but we have no pre-determined loss limit then the differences between the strategies will be similar to

Figure 5. Defining the RBPI cushion to be a function of the initial delta of OBPI means we can derive the initial cushion for the CPPI style process that gives both the same starting delta.

$$m_t^{CPPI} = \frac{1}{\lambda \sigma_t}$$

$$C_0^{CPPI} = \frac{S_0 \mathcal{N}(d_1(0, S_0))}{m_0^{CPPI}}$$

Doing this gives us the difference in delta and 50% hedged benchmark relative performance shown in Figure 6 below:

Figure 6 – Difference in hedge ratio and cumulative value added by OBPI and RBPI for AUD/USD for the base strategies defined in the previous section
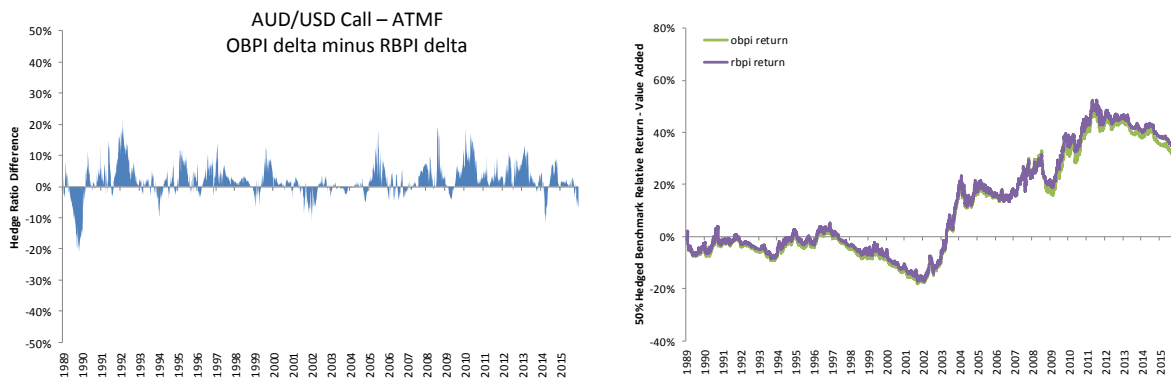
For a given tenor and volatility, CPPI-based strategies have the portfolio insurance cost pre-determined and defined by the investor with the strike left as a function of the realised dynamic hedging outcome. In OBPI the strike or moneyness is typically pre-determined and defined by the investor with the portfolio insurance cost left as a function of the realised dynamic hedging outcome. Therefore, either equalising OBPI option cost with the CPPI cushion or equalising CPPI delta with OBPI option delta at initiation is necessary for a pure comparison between the two and the differences between the strategies is clearly just a matter of configuration. The only inherent, persistent difference between the two is slight differences in their functional forms.

If we are considering these strategies for portfolio insurance applications where a pre-agreed maximum cost is a feature we want to preserve, then the most appropriate method of comparison of these strategies is equalising the OBPI option cost with a given, pre-determined portfolio insurance cushion.

If we are considering these strategies as proxies for the currency momentum factor, then it's most appropriate to equalise RBPI delta with OBPI option delta at initiation for the base case comparison. This is essentially how RBPI is applied in its role as the proxy for momentum in FNA – where its risk-free position is 50% and the cushion on each slice is defined to be that which gives an initial delta of 50% i.e. the neutral starting point for a momentum strategy, neither long nor short.

After equalising the maximum cost or the initial delta, it should just be the differences in the functional forms of CPPI and Black-Scholes delta-hedging that is the only thing explaining the remaining difference in hedging outcome and this difference will be small when you are dealing with strategies that have leverage constraints i.e. are bound between 0% and 100%. This was clearly shown in the 2014 paper in the context of our CRM strategy, where portfolio insurance has a pre-agreed maximum cost. We expect to see the same results here for the momentum strategy application.

For all these reasons, it was recommended in the 2014 paper that we not expend any further effort on assessing detail about the differences between options-based and CPPI-based strategies. This is not only because differences should be marginal once you equalise for hedging volatility and either maximum cost or delta but, more importantly, because choices regarding the latter are independent of the strategy and ultimately determined by solution design or our target market. What's more, the difference between the two has been covered extensively in the academic literature and we can simply refer to existing research. The same goes for all the properties of CPPI-based strategies under different model conditions and with different features.

Since 2014, for some North American and UK overlays, we have begun pursuing OBPI for application within CRM in a manner that is in effect similar to equalising option cost with a CPPI style cushion – since it is ultimately wrapped in a CPPI-based process in our constraints. In addition we have added other features, like those that existed in legacy CRM, to the pure OBPI process. Our RBPI-Momentum adopts a naïve approach and applies all the same naïve feature settings determined as part of the 2014 paper.

In summary, we expect the simulations of the core base cases for the OBPI-Momentum and RBPI-Momentum strategies to be practically indistinguishable and based on the 2014 work, the features we expect to be the most valuable are the volatility estimation and the rebalancing discipline.

2.1   Scope and method of the analysis

We begin the analysis with the core base strategies we have defined for both momentum strategies, labelled as RBPI and OBPI, in the diagram shown in Figure 1 earlier. We then assess the impact of each feature, by adding it to the base case and contrasting the outcome to that associated with the base case. Finally, we produce results for the momentum strategies with all the component features listed above as they are running in the live environment with client money.

Although the base strategies RBPI and OBPI can be viewed as naïve comparators, in addition to these we define a "simple moving average" (SMA) momentum model as a naïve comparator throughout this analysis. This gives additional context when assessing the performance of momentum as this model is based purely on relative price changes and has been defined as follows:

$$Exp_{SMA,t} = \begin{cases} 100\%, & Spot_{\frac{Local}{Base}} \geq N - day_{\text{ }moving\text{ }average} \\ 0\%, & Spot_{\frac{Local}{Base}} < N - day_{moving\text{ }average} \end{cases}$$

All results presented are the average of N strike points (the exchange rate at which the strategy is initiated) for each strategy. N is therefore the number of simulations for each strategy and represents unique days in the tenor of the strategy we are considering. This removes noise arising from path dependencies in the simulation and associated with lucky/unlucky strikes. For the SMA model for example, N is the number of days in the moving average lookback window and is analogous to strike in the RBPI-Momentum and OBPI-Momentum strategies.

Previous sections have provided some coverage of the theoretical foundations explaining why we shouldn't expect any material difference in the results produced by either the base forms: OBPI and RBPI. In addition, we expect the differences introduced by the features built on top of the base forms to be marginal and for risk estimation and the rebalancing discipline to be the most attractive features. To correctly test these beliefs we need to run the two strategies in a strictly controlled experiment where both have identical inputs and identical return calculation methodologies. This has been done in the form of an Excel spreadsheet based simulator, which makes the process and methodology transparent. It also had the advantage of allowing us to distribute the spreadsheet and the template for the summary statistics amongst stakeholders in order to establish agreement on the methodology and process.

For the base case simulations, we assume the following:

- Our default minimum trade constraint of 5% as the rebalancing discipline;

- Standard risk estimation: 260 day risk horizon period (exponentially weighted moving average - EWMA with λ of 0.992);

- Initial delta of approximately 50%

- 12 months tenor

Each OBPI-Momentum and RBPI-Momentum feature is then implemented by only over-riding the base case feature which it effects allowing us to get a measure of the impact of each feature in isolation.

All simulations are run from 1989 to 2015 and cover the 21 currency pairs in the set derived from the major 7 currencies that together account for over 80% of global FX turnover and cover almost all of our overlay exposures under management. This set of currencies is shown in the table below:

Table 1 – Universe of currency pairs within the scope of this analysis

	AUD	CAD	CHF	EUR	GBP	JPY	USD
AUD							
CAD	AUDCAD						
CHF	AUDCHF	CADCHF					
EUR	AUDEUR	CADEUR	CHFEUR				
GBP	AUDGBP	CADGBP	CHFGBP	EURGBP			
JPY	AUDJPY	CADJPY	CHFJPY	EURJPY	GBPJPY		
USD	AUDUSD	CADUSD	CHFUSD	EURUSD	GBPUSD	JPYUSD	

Based on the February 2015 publication from Morgan Stanley Quantitative Solutions and Innovations titled "How Much Does it Cost to Trade 50M?", we estimate the average trading cost on the 21 currency pairs above to be 0.092%. Assuming this represents an average bid-ask, for the purposes of this analysis we assume an average bid-mid of 0.05% for every hedge ratio adjustment.

We produce results for every combination of currency pair (represented in Table 1 above) and feature listed below:

1. Base case

2. Tenor

3. Rebalancing discipline

4. Time to expiry function

5. Delta adjustment

6. Risk estimation

7. Live strategy

In addition we produce results for an equally weighted basket of the 21 currency pairs in a cross-hedging application via AUD, and MSCI World equity index weighted baskets of foreign currency exposures hedged back to each currency as the base.

In an attempt to limit the size of this report, we only present and discuss the results for MSCI World ex AUD; MSCI World ex USD and the equally weighted basket of 21 pairs in a cross-hedging application. Interested readers are invited to review, the results for any currency pair or basket in the following location: File://S:\Research\Momentum\ where the sub-folders are labelled to indicate the feature the simulations relate to and the filenames indicated whether the results are for a basket or individual currency. We advise the reader to check only the files in the sub-subfolders named "log", which use logarithm returns that correctly account for P/L conversions from different bases other than AUD.

3 Simulation results

In this section we highlight a sub-set of the results that covers most of our overlay assets under management as described previously. In the charts, tables and discussion that follows we attach the generic OBPI or RBPI labels to all instances regardless of the feature set being considered. For example, the final results, in the "Live Strategy" section are the results for the OBPI-Momentum and RBPI-Momentum strategies that we are running live money on.

We adopt two methods of aggregation of the individual currency pair results:

1. **MSCI World foreign exposure baskets – 6 currencies hedged back to base currency**

    This is the strict hedging mandate configuration where we hedge an exposure set which is a tracking basket on MSCI World foreign equity exposure. These baskets hedged back to an Australian dollar and US dollar base should cover most of our overlay assets under management. Figures 6 and 7 show the evolution through time of the tracking basket weights used for our simulations, respectively for the MSCI ex-AUD (proxy for our Australian based clients' currency portfolio weights) and MSCI ex-USD basket (proxy for our USD based clients' currency portfolio weights).

    For these results we present:

    a) Cumulative return chart for each strategy and the time series of hedge ratios

    b) Chart showing a payoff profile fitted to rolling annual returns for each strategy

    c) Table of annual absolute returns and returns relative to the sample average hedge ratio for each strategy

    d) Table of summary statistics

    Figure 6 –MSCI ex-AUD tracking basket weights evolution
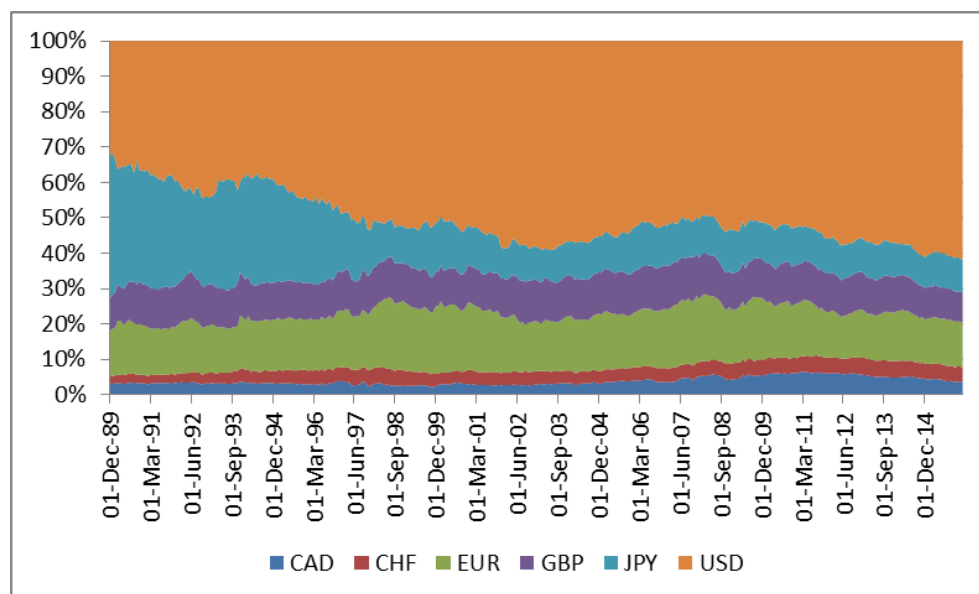
Figure 7 –MSCI ex-USD tracking basket weights evolution
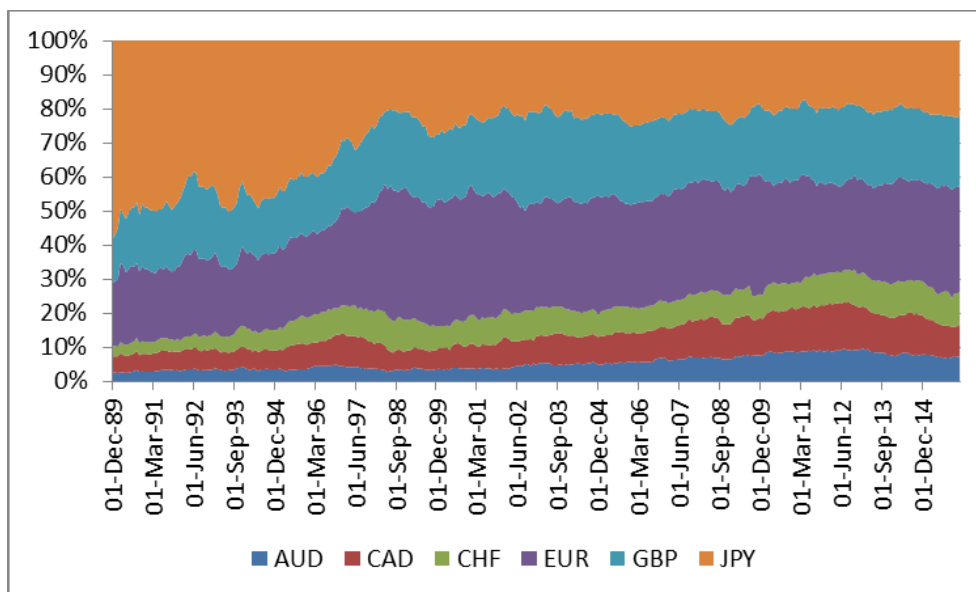
2. **Equally weighted cross-hedging via AUD**

Hedging mandates don't allow for cross hedging but we include these equally weighted cross-hedging aggregate results in an effort to produce a fair aggregate comparison of the signal performance more generally that is not skewed by the currency with the largest tracking basket weight in a typical MSCI World exposure basket . For example for an AUD base account, AUDUSD has a weight of approximately 55% in the basket (as indicated in Figure 7).

For these results we present:

e) Cumulative return chart for each strategy and the time series of hedge ratios

f) Chart depicting the time-varying differences in hedge ratios between OBPI and RBPI

g) Chart showing the rolling annual Sortino ratio (return per unit of negative semi-deviation in return)

h) Table of annual absolute returns and returns relative to the sample average hedge ratio for each strategy

i) Table of summary statistics

For each method of aggregation above, we present the results for each one of the component parts described in Figure 1, starting with the base case.

3.1 MSCI World foreign exposure baskets – 6 currencies hedged back to base currency

3.1.1 Base case

Figure 8 – Cumulative profit/loss from hedging MSCI World ex AUD exposure to AUD
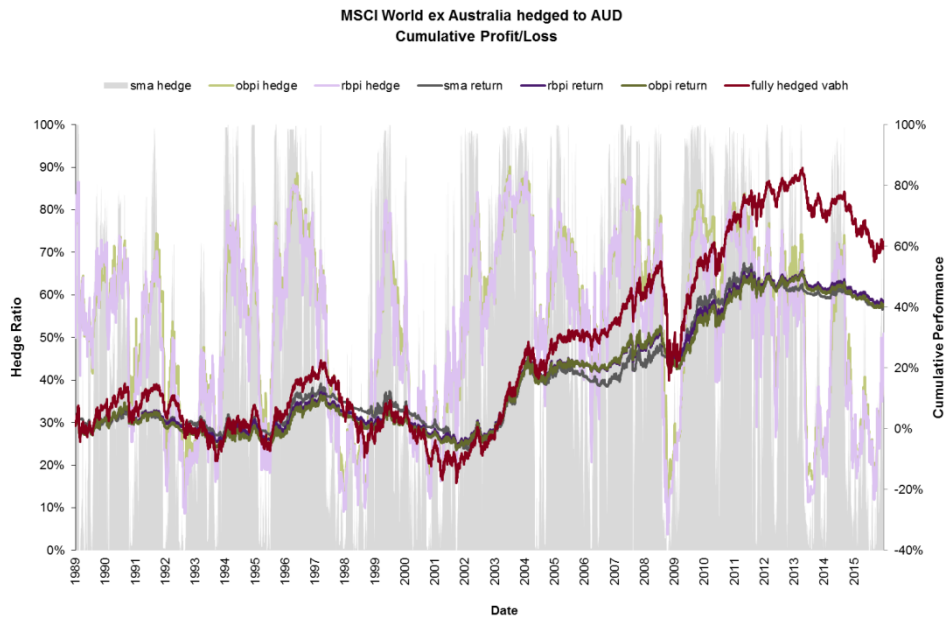
Figure 9 – Profit/loss payoff from hedging MSCI World ex AUD exposure to AUD

INSIGHT INVESTMENT

Table 2 – Annual absolute/relative return for MSCI World ex AUD exposure to AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	7.52%	2.87%	9.57%	3.16%	3.28%	2.88%	4.99%	-0.92%	-0.63%	-0.98%
1990	-1.78%	6.65%	0.06%	-1.03%	-0.64%	-0.00%	1.15%	-0.07%	0.29%	0.92%
1991	-0.44%	2.29%	3.80%	-1.45%	-0.64%	-0.37%	4.07%	-1.21%	-0.41%	-0.15%
1992	-5.39%	0.12%	0.45%	-2.23%	-1.98%	-0.72%	3.73%	0.69%	0.82%	2.05%
1993	-1.73%	0.00%	2.00%	-1.97%	-1.99%	-2.28%	3.06%	-1.03%	-1.09%	-1.39%
1994	8.81%	5.52%	5.69%	4.00%	4.27%	3.55%	0.33%	-0.77%	-0.31%	-0.98%
1995	-2.26%	1.26%	3.52%	-2.14%	-2.51%	-1.79%	4.90%	-0.92%	-1.34%	-0.63%
1996	13.22%	13.51%	12.81%	9.90%	9.39%	9.97%	4.77%	2.74%	2.52%	3.18%
1997	-13.40%	3.87%	0.14%	-4.31%	-3.91%	-2.50%	8.29%	2.95%	3.05%	4.38%
1998	-8.77%	0.00%	-1.76%	-4.05%	-4.10%	-5.06%	3.58%	0.69%	0.45%	-0.56%
1999	9.63%	4.65%	7.22%	3.26%	3.10%	3.72%	1.36%	-1.96%	-1.90%	-1.23%
2000	-11.67%	0.64%	0.06%	-5.00%	-5.32%	-5.86%	7.16%	1.32%	0.75%	0.13%
2001	-3.87%	0.08%	0.86%	-3.11%	-3.28%	-7.81%	3.22%	-1.01%	-1.27%	-5.82%
2002	6.80%	6.04%	6.65%	3.61%	3.44%	3.20%	2.52%	-0.07%	-0.10%	-0.29%
2003	26.69%	15.88%	26.69%	20.53%	20.54%	22.11%	10.46%	6.08%	6.68%	8.39%
2004	4.85%	12.21%	4.85%	1.21%	1.21%	0.31%	1.90%	-1.42%	-1.31%	-2.19%
2005	1.67%	6.95%	1.97%	0.38%	-0.11%	-2.02%	0.96%	-0.53%	-0.98%	-2.88%
2006	5.39%	1.55%	5.50%	1.84%	1.45%	-0.28%	2.22%	-1.08%	-1.35%	-3.05%
2007	9.12%	9.89%	9.37%	4.88%	4.50%	4.12%	3.83%	-0.06%	-0.24%	-0.57%
2008	-16.13%	6.83%	2.56%	-5.64%	-2.46%	2.53%	12.37%	3.09%	5.92%	10.81%
2009	26.18%	8.11%	21.99%	13.81%	13.73%	17.20%	6.07%	-0.36%	0.13%	3.75%
2010	16.82%	18.71%	16.82%	10.62%	9.75%	10.43%	6.59%	1.52%	1.01%	1.78%
2011	4.70%	13.05%	4.66%	0.51%	0.01%	-4.68%	1.79%	-2.03%	-2.43%	-7.09%
2012	5.13%	6.19%	4.68%	1.80%	1.39%	-1.32%	1.56%	-0.97%	-1.28%	-3.95%
2013	-10.88%	1.87%	-0.18%	-3.68%	-3.08%	-1.84%	6.43%	2.21%	2.57%	3.75%
2014	-2.00%	1.02%	1.71%	-1.34%	-1.02%	0.34%	2.92%	-0.26%	0.02%	1.37%
2015	-6.76%	0.00%	0.00%	-2.67%	-2.97%	-3.95%	4.11%	0.99%	0.54%	-0.47%

Table 3 – Summary statistics for absolute/relative return for MSCI World ex AUD exposure to AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	2.27%	5.53%	5.60%	1.51%	1.55%	1.47%	4.22%	0.28%	0.37%	0.31%
Median	2.85%	2.85%	3.96%	0.59%	0.53%	0.30%				
Skew	0.07	1.52	1.18	0.88	1.04	1.28				
Volatility	11.11%	0.43%	7.13%	5.64%	5.39%	5.69%	4.19%	2.89%	3.04%	4.27%
Negative Semi-deviation			8.04%	6.22%	5.93%	6.11%				
Average drawdown			-2.07%	-6.62%	-6.06%	-6.89%				
Maximum drawdown			-12.07%	-18.32%	-18.29%	-21.95%				
% Positive Years	54%	92%	83%	53%	53%	53%	97%	52%	50%	52%
Average Hedge Ratio	100%			54%	52%	51%				
Information Ratio	0.20	12.84	0.79	0.27	0.29	0.26	1.01	0.10	0.12	0.07
Sortino Ratio				0.24	0.26	0.24				
Calmar Ratio				0.08	0.08	0.07				
Average Rolling 1yr Return (Relative to free option)				-3.99%	-3.94%	-4.00%				
Negative Semi-deviation (Relative to free option)				4.71%	4.73%	5.33%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-4.06%	-4.01%	-4.07%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.61%	4.45%	4.80%				
Turnover				2.19	2.86	12.62				
Trade Size (5th Pctile)				0.14%	0.16%	0.25%				
Trade Size (20th Pctile)				0.28%	0.33%	0.95%				
Trade Size (50th Pctile)				0.94%	1.07%	3.42%				
Trade Size (Average)				1.74%	1.99%	5.82%				
Trade Size (80th Pctile)				3.03%	3.42%	9.41%				
Trade Size (95th Pctile)				5.44%	6.03%	19.42%				
Trade Size (99th Pctile)				8.06%	9.26%	34.31%				

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Figure 10 – Cumulative profit/loss from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Cumulative Profit/Loss
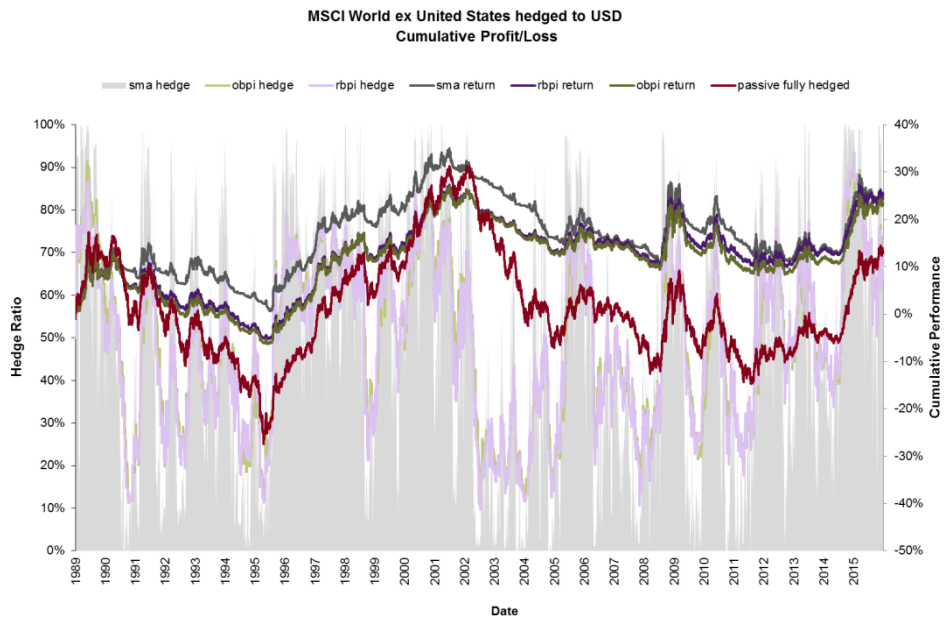
Figure 11 – Profit/loss payoff from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Payoff - Rolling 1 Year Profit/Loss

Table 4 – Annual absolute/relative return for MSCI World ex USD exposure to USD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	10.79%	9.76%	12.13%	8.04%	7.87%	8.64%	6.66%	2.67%	2.54%	3.35%
1990	-9.24%	3.24%	1.15%	-2.32%	-1.72%	0.52%	5.84%	2.28%	2.84%	5.05%
1991	-5.68%	0.43%	0.12%	-3.88%	-2.89%	-0.35%	3.00%	-1.05%	-0.09%	2.44%
1992	3.39%	0.13%	1.24%	1.07%	1.00%	2.32%	-0.48%	-0.62%	-0.67%	0.66%
1993	-4.28%	0.30%	-0.65%	-1.88%	-1.96%	-2.50%	1.52%	0.25%	0.15%	-0.40%
1994	-9.14%	0.00%	0.27%	-4.53%	-4.81%	-4.83%	4.91%	0.02%	-0.30%	-0.34%
1995	0.76%	0.20%	5.06%	1.60%	1.34%	2.12%	4.67%	1.22%	0.96%	1.75%
1996	8.22%	10.04%	8.22%	6.89%	6.58%	7.39%	4.05%	2.80%	2.52%	3.36%
1997	12.93%	11.06%	12.66%	8.83%	8.68%	8.02%	6.11%	2.39%	2.30%	1.67%
1998	-3.83%	5.89%	-1.82%	-2.62%	-2.31%	-2.69%	0.12%	-0.72%	-0.42%	-0.81%
1999	6.97%	2.09%	6.03%	3.11%	3.31%	4.46%	2.50%	-0.36%	-0.13%	1.04%
2000	10.75%	9.35%	10.77%	6.63%	6.81%	7.58%	5.32%	1.28%	1.51%	2.31%
2001	7.07%	7.81%	6.42%	3.77%	3.13%	0.14%	2.83%	0.25%	-0.36%	-3.33%
2002	-12.86%	1.47%	0.30%	-4.52%	-4.52%	-3.95%	6.82%	1.88%	1.82%	2.35%
2003	-15.66%	0.00%	0.00%	-4.14%	-4.02%	-3.98%	7.94%	3.65%	3.71%	3.70%
2004	-7.37%	0.00%	-1.87%	-3.51%	-3.50%	-6.86%	1.86%	0.16%	0.14%	-3.25%
2005	12.64%	2.18%	8.57%	5.08%	5.51%	5.32%	2.16%	-1.21%	-0.73%	-0.88%
2006	-4.99%	3.00%	-1.41%	-3.23%	-3.31%	-5.48%	1.12%	-0.74%	-0.84%	-3.03%
2007	-6.35%	0.04%	-0.13%	-2.68%	-2.76%	-1.76%	3.08%	0.48%	0.38%	1.35%
2008	7.21%	2.38%	9.25%	6.62%	7.35%	8.95%	5.59%	3.03%	3.79%	5.41%
2009	-6.51%	7.08%	-0.24%	-4.93%	-4.85%	-5.27%	3.06%	-1.69%	-1.64%	-2.08%
2010	-2.70%	0.92%	1.42%	-2.14%	-1.66%	-0.98%	2.79%	-0.79%	-0.32%	0.35%
2011	0.02%	0.01%	2.81%	-0.92%	-1.26%	-2.45%	2.79%	-0.94%	-1.27%	-2.47%
2012	-0.13%	2.99%	0.09%	-0.92%	-1.05%	-2.23%	0.16%	-0.86%	-0.99%	-2.16%
2013	3.75%	3.93%	4.47%	2.40%	2.69%	2.40%	2.57%	0.53%	0.83%	0.56%
2014	10.28%	2.61%	10.60%	7.23%	7.49%	8.30%	5.39%	2.11%	2.42%	3.26%
2015	7.51%	13.10%	7.51%	4.50%	4.39%	1.93%	3.70%	0.76%	0.68%	-1.76%

Table 5 – Summary statistics for absolute/relative return for MSCI World ex USD exposure to USD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	0.50%	3.69%	3.80%	0.87%	0.94%	0.91%	3.55%	0.62%	0.70%	0.67%
Median	0.19%	0.19%	1.92%	-0.32%	-0.20%	0.22%				
Skew	(0.01)	1.12	0.87	0.54	0.55	0.53				
Volatility	7.69%	0.31%	4.65%	4.38%	4.35%	4.85%	2.72%	1.95%	2.00%	2.91%
Negative Semi-deviation			4.91%	4.57%	4.53%	4.97%				
Average drawdown			-2.42%	-9.86%	-9.03%	-10.82%				
Maximum drawdown			-7.57%	-19.68%	-18.20%	-24.67%				
% Positive Years	50%	88%	71%	47%	48%	52%	98%	62%	64%	59%
Average Hedge Ratio	100%			50%	49%	49%				
Information Ratio	0.07	12.00	0.82	0.20	0.22	0.19	1.30	0.32	0.35	0.23
Sortino Ratio				0.19	0.21	0.18				
Calmar Ratio				0.04	0.05	0.04				
Average Rolling 1yr Return (Relative to free option)				-2.87%	-2.79%	-2.76%				
Negative Semi-deviation (Relative to free option)				3.47%	3.42%	3.86%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.87%	-2.79%	-2.77%				
Negative Semi-deviation (Relative to investable perfect hedge)				3.22%	3.12%	3.44%				
Turnover				1.92	2.53	11.16				
Trade Size (5th Pctile)				0.16%	0.18%	0.32%				
Trade Size (20th Pctile)				0.39%	0.43%	1.06%				
Trade Size (50th Pctile)				1.15%	1.25%	3.23%				
Trade Size (Average)				1.50%	1.71%	5.01%				
Trade Size (80th Pctile)				2.30%	2.59%	7.95%				
Trade Size (95th Pctile)				4.26%	4.98%	15.49%				
Trade Size (99th Pctile)				6.43%	7.65%	24.65%				

The base case is essentially showing that these core forms of portfolio insurance strategy applied to a risk free position of 50% hedged (ATMF) in their application as momentum strategies are practically indistinguishable, which is consistent with the theory. Notably, the simple moving average model performs as well in risk-adjusted return terms as the other momentum strategies but this is associated with considerably higher turnover as it goes fully long or fully short for each crossover of the moving average.

While, statistically speaking, OBPI and RBPI momentum base cases are essentially equivalent, we note that these differences can vary with time. If our metrics of choice are to be objective and strictly based on risk-adjusted return and deviation from the "free option / investable perfect hedge" then these would favour RBPI at the margin. However, since these are practically the same, if we were to choose between the two our choice would be a highly subjective one.

Based on these results, we assume a degree of "transitivity" for the remainder of this analysis. That is, if the OBPI base case is equivalent to RBPI base case, then the impact of additional features specific to RBPI-Momentum should be roughly equivalent to their impact should they be implemented in OBPI-Momentum. We can use either base case as a comparator when assessing the impact of any feature.

3.1.2   Tenor

Figure 12 – Cumulative profit/loss from hedging MSCI World ex AUD exposure to AUD

Figure 13 – Profit/loss payoff from hedging MSCI World ex AUD exposure to AUD

Table 6 – Annual absolute/relative return for MSCI World ex AUD exposure to AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	7.52%	2.87%	9.57%	3.30%	3.19%	2.31%	4.99%	-0.73%	-0.71%	-1.62%
1990	-1.78%	6.65%	0.06%	-0.38%	-0.20%	0.55%	1.15%	0.58%	0.72%	1.48%
1991	-0.44%	2.29%	3.80%	0.93%	0.94%	-0.31%	4.07%	1.17%	1.17%	-0.07%
1992	-5.39%	0.12%	0.45%	-2.35%	-2.20%	-0.45%	3.73%	0.54%	0.60%	2.36%
1993	-1.73%	0.00%	2.00%	-2.21%	-2.23%	-1.11%	3.06%	-1.29%	-1.34%	-0.21%
1994	8.81%	5.52%	5.69%	4.35%	4.45%	2.48%	0.33%	-0.37%	-0.12%	-2.12%
1995	-2.26%	1.26%	3.52%	-0.42%	0.09%	-0.48%	4.90%	0.80%	1.26%	0.70%
1996	13.22%	13.51%	12.81%	8.67%	8.30%	7.80%	4.77%	1.59%	1.44%	0.91%
1997	-13.40%	3.87%	0.14%	-4.67%	-4.31%	-4.38%	8.29%	2.50%	2.64%	2.61%
1998	-8.77%	0.00%	-1.76%	-5.88%	-5.59%	-6.75%	3.58%	-1.19%	-1.04%	-2.17%
1999	9.63%	4.65%	7.22%	3.92%	3.94%	3.53%	1.36%	-1.24%	-1.06%	-1.49%
2000	-11.67%	0.64%	0.06%	-6.14%	-6.10%	-5.93%	7.16%	0.11%	-0.04%	0.16%
2001	-3.87%	0.08%	0.86%	-5.10%	-5.43%	-7.38%	3.22%	-3.03%	-3.42%	-5.36%
2002	6.80%	6.04%	6.65%	3.34%	3.04%	2.22%	2.52%	-0.30%	-0.49%	-1.33%
2003	26.69%	15.88%	26.69%	19.67%	19.87%	20.01%	10.46%	5.38%	6.03%	6.09%
2004	4.85%	12.21%	4.85%	1.54%	1.32%	1.48%	1.90%	-1.06%	-1.20%	-1.05%
2005	1.67%	6.95%	1.97%	-0.53%	-0.79%	-3.55%	0.96%	-1.43%	-1.66%	-4.42%
2006	5.39%	1.55%	5.50%	1.69%	1.17%	-0.66%	2.22%	-1.20%	-1.62%	-3.47%
2007	9.12%	9.89%	9.37%	3.76%	3.15%	4.92%	3.83%	-1.13%	-1.58%	0.16%
2008	-16.13%	6.83%	2.56%	-2.38%	-1.02%	2.39%	12.37%	6.25%	7.35%	10.80%
2009	26.18%	8.11%	21.99%	18.03%	15.57%	15.48%	6.07%	4.02%	2.00%	1.83%
2010	16.82%	18.71%	16.82%	9.74%	9.08%	10.75%	6.59%	0.74%	0.36%	1.98%
2011	4.70%	13.05%	4.66%	-0.44%	-1.10%	-6.48%	1.79%	-2.95%	-3.54%	-8.93%
2012	5.13%	6.19%	4.68%	0.87%	1.46%	0.83%	1.56%	-1.88%	-1.20%	-1.85%
2013	-10.88%	1.87%	-0.18%	-3.80%	-3.12%	-1.88%	6.43%	2.03%	2.52%	3.79%
2014	-2.00%	1.02%	1.71%	-0.14%	-0.05%	0.33%	2.92%	0.93%	0.99%	1.37%
2015	-6.76%	0.00%	0.00%	-4.13%	-4.50%	-6.03%	4.11%	-0.51%	-0.99%	-2.50%

Table 7 – Summary statistics for absolute/relative return for MSCI World ex AUD exposure to AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	2.27%	5.53%	5.60%	1.52%	1.44%	1.10%	4.22%	0.31%	0.26%	-0.09%
Median	2.85%	2.85%	3.96%	0.76%	0.79%	0.40%				
Skew	0.07	1.52	1.18	1.01	0.96	1.01				
Volatility	11.11%	0.43%	7.13%	5.56%	5.37%	5.80%	4.19%	2.89%	2.94%	4.28%
Negative Semi-deviation			8.04%	6.07%	5.87%	6.16%				
Average drawdown			-2.07%	-6.30%	-6.01%	-7.48%				
Maximum drawdown			-12.07%	-22.35%	-21.67%	-25.60%				
% Positive Years	54%	92%	83%	56%	57%	54%	97%	51%	50%	48%
Average Hedge Ratio	100%			54%	52%	52%				
Information Ratio	0.20	12.84	0.79	0.27	0.27	0.19	1.01	0.11	0.09	(0.02)
Sortino Ratio				0.25	0.25	0.18				
Calmar Ratio				0.07	0.07	0.04				
Average Rolling 1yr Return (Relative to free option)				-3.96%	-4.03%	-4.34%				
Negative Semi-deviation (Relative to free option)				4.80%	5.06%	5.75%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-4.03%	-4.11%	-4.41%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.41%	4.56%	5.21%				
Turnover				3.83	4.99	18.48				
Trade Size (5th Pctile)				0.17%	0.18%	0.30%				
Trade Size (20th Pctile)				0.43%	0.53%	1.37%				
Trade Size (50th Pctile)				1.34%	1.69%	4.94%				
Trade Size (Average)				2.36%	2.74%	8.02%				
Trade Size (80th Pctile)				4.07%	4.67%	12.87%				
Trade Size (95th Pctile)				7.22%	8.33%	25.54%				
Trade Size (99th Pctile)				10.86%	12.47%	44.29%				

INSIGHT INVESTMENT

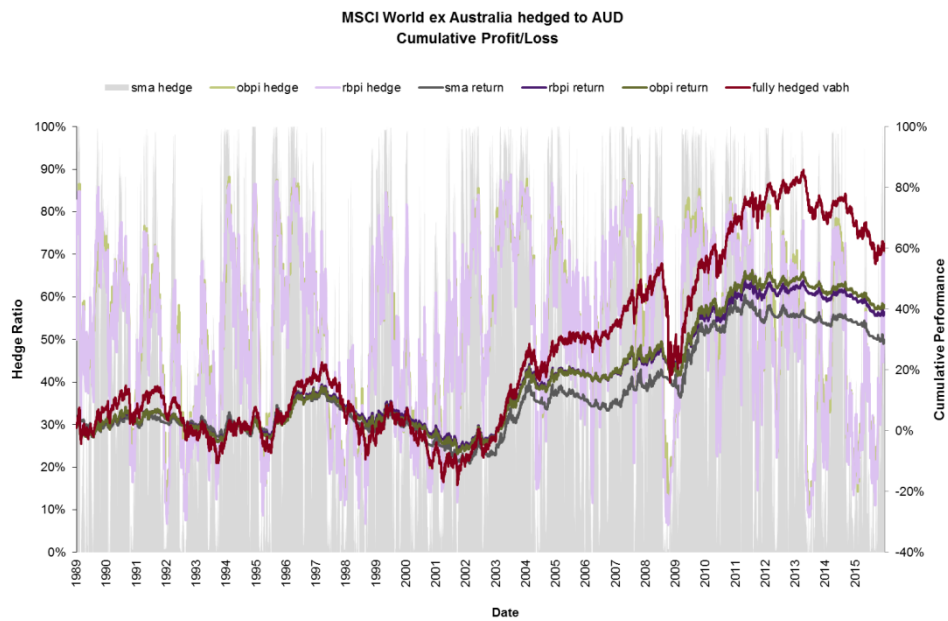Figure 14 – Cumulative profit/loss from hedging MSCI World ex USD exposure to USD

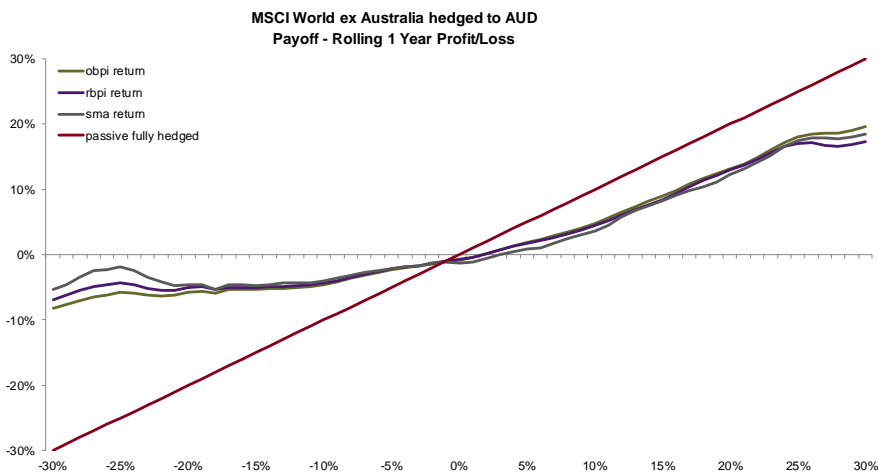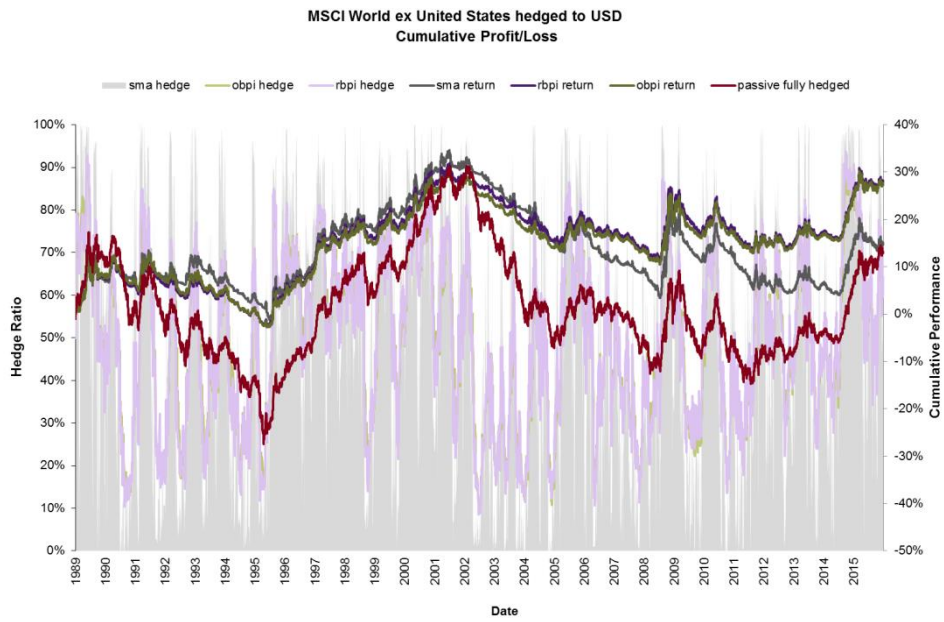Figure 15 – Profit/loss payoff from hedging MSCI World ex USD exposure to USD
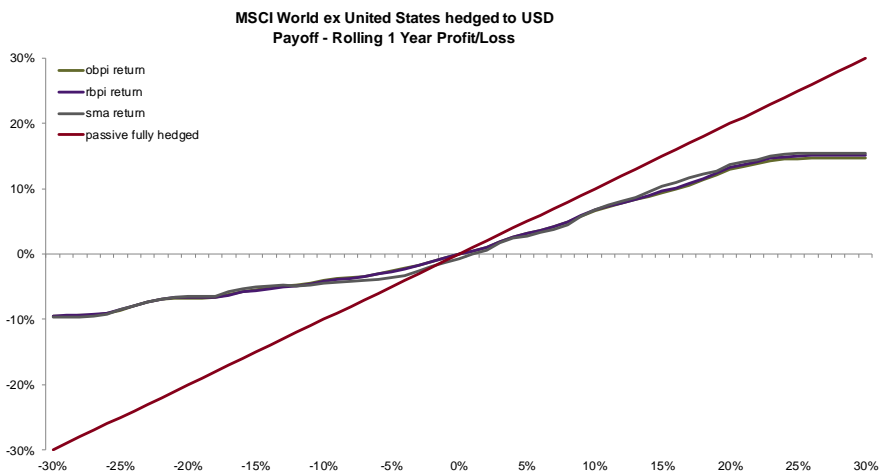
Table 8 – Annual absolute/relative return for MSCI World ex USD exposure to USD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	10.79%	9.76%	12.13%	7.97%	7.66%	7.15%	6.66%	2.58%	2.29%	1.79%
1990	-9.24%	3.24%	1.15%	-1.02%	-1.34%	0.61%	5.84%	3.60%	3.27%	5.20%
1991	-5.68%	0.43%	0.12%	0.01%	-0.28%	0.15%	3.00%	2.85%	2.56%	2.97%
1992	3.39%	0.13%	1.24%	1.34%	1.20%	3.70%	-0.48%	-0.36%	-0.49%	2.01%
1993	-4.28%	0.30%	-0.65%	-2.55%	-1.89%	-3.19%	1.52%	-0.41%	0.24%	-1.07%
1994	-9.14%	0.00%	0.27%	-5.06%	-4.73%	-4.97%	4.91%	-0.49%	-0.17%	-0.44%
1995	0.76%	0.20%	5.06%	2.83%	3.39%	1.47%	4.67%	2.45%	3.01%	1.10%
1996	8.22%	10.04%	8.22%	5.91%	5.89%	6.01%	4.05%	1.81%	1.79%	1.93%
1997	12.93%	11.06%	12.66%	7.61%	7.89%	8.77%	6.11%	1.14%	1.44%	2.35%
1998	-3.83%	5.89%	-1.82%	-2.17%	-1.89%	-2.20%	0.12%	-0.26%	0.02%	-0.30%
1999	6.97%	2.09%	6.03%	4.10%	4.02%	4.80%	2.50%	0.62%	0.54%	1.34%
2000	10.75%	9.35%	10.77%	6.71%	7.25%	7.88%	5.32%	1.34%	1.89%	2.55%
2001	7.07%	7.81%	6.42%	2.00%	2.11%	1.40%	2.83%	-1.53%	-1.41%	-2.12%
2002	-12.86%	1.47%	0.30%	-4.47%	-4.40%	-4.81%	6.82%	1.96%	2.01%	1.57%
2003	-15.66%	0.00%	0.00%	-5.18%	-5.13%	-4.72%	7.94%	2.64%	2.67%	3.05%
2004	-7.37%	0.00%	-1.87%	-4.10%	-4.39%	-6.92%	1.86%	-0.42%	-0.72%	-3.26%
2005	12.64%	2.18%	8.57%	5.78%	5.48%	3.42%	2.16%	-0.54%	-0.83%	-2.86%
2006	-4.99%	3.00%	-1.41%	-3.39%	-3.70%	-7.04%	1.12%	-0.89%	-1.21%	-4.56%
2007	-6.35%	0.04%	-0.13%	-2.95%	-3.07%	-2.68%	3.08%	0.22%	0.09%	0.47%
2008	7.21%	2.38%	9.25%	7.64%	8.32%	9.29%	5.59%	4.03%	4.73%	5.71%
2009	-6.51%	7.08%	-0.24%	-3.79%	-4.18%	-5.92%	3.06%	-0.54%	-0.93%	-2.69%
2010	-2.70%	0.92%	1.42%	-0.62%	-0.78%	-0.27%	2.79%	0.73%	0.57%	1.07%
2011	0.02%	0.01%	2.81%	-1.00%	-1.53%	-4.69%	2.79%	-1.01%	-1.54%	-4.70%
2012	-0.13%	2.99%	0.09%	-1.10%	-0.85%	-2.07%	0.16%	-1.03%	-0.79%	-2.00%
2013	3.75%	3.93%	4.47%	2.28%	2.21%	1.35%	2.57%	0.40%	0.34%	-0.51%
2014	10.28%	2.61%	10.60%	7.63%	7.71%	7.48%	5.39%	2.49%	2.59%	2.37%
2015	7.51%	13.10%	7.51%	3.35%	3.23%	1.09%	3.70%	-0.40%	-0.51%	-2.63%

Table 9 – Summary statistics for absolute/relative return for MSCI World ex USD exposure to USD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	0.50%	3.69%	3.80%	1.02%	1.04%	0.56%	3.55%	0.77%	0.79%	0.31%
Median	0.19%	0.19%	1.92%	0.50%	0.46%	0.60%				
Skew	(0.01)	1.12	0.87	0.46	0.47	0.41				
Volatility	7.69%	0.31%	4.65%	4.36%	4.38%	4.88%	2.72%	1.93%	2.00%	2.92%
Negative Semi-deviation			4.91%	4.51%	4.50%	4.94%				
Average drawdown			-2.42%	-8.73%	-9.06%	-13.12%				
Maximum drawdown			-7.57%	-20.02%	-20.79%	-31.19%				
% Positive Years	50%	88%	71%	54%	53%	53%	98%	66%	66%	56%
Average Hedge Ratio	100%			50%	50%	50%				
Information Ratio	0.07	12.00	0.82	0.23	0.24	0.11	1.30	0.40	0.40	0.11
Sortino Ratio				0.23	0.23	0.11				
Calmar Ratio				0.05	0.05	0.02				
Average Rolling 1yr Return (Relative to free option)				-2.69%	-2.67%	-3.11%				
Negative Semi-deviation (Relative to free option)				3.58%	3.57%	4.39%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.70%	-2.67%	-3.11%				
Negative Semi-deviation (Relative to investable perfect hedge)				3.14%	3.10%	3.90%				
Turnover				3.34	4.38	16.47				
Trade Size (5th Pctile)				0.19%	0.20%	0.37%				
Trade Size (20th Pctile)				0.46%	0.53%	1.35%				
Trade Size (50th Pctile)				1.39%	1.57%	4.42%				
Trade Size (Average)				1.95%	2.29%	6.96%				
Trade Size (80th Pctile)				3.09%	3.59%	11.38%				
Trade Size (95th Pctile)				5.82%	6.78%	21.87%				
Trade Size (99th Pctile)				8.52%	10.29%	34.81%				

Introducing the 6 month tenor feature to the base strategies appears to have very little effect on the results other than to increase turnover as the average gamma of the book of "options" underlying each strategy is increased. There is no net gain in terms of any significant improvement in risk-adjusted return statistics or deviation from the "free option".

This too is consistent with theory. Adopting a 6 month tenor as a feature of our momentum strategy should require us to ask some questions like: Why should 6 month options be better value-for-money than 12 month options? If empirically they appear to be then why doesn't this difference get arbitraged away?

3.1.3 Rebalancing discipline

Figure 16 – Cumulative profit/loss from hedging MSCI World ex AUD exposure to AUD
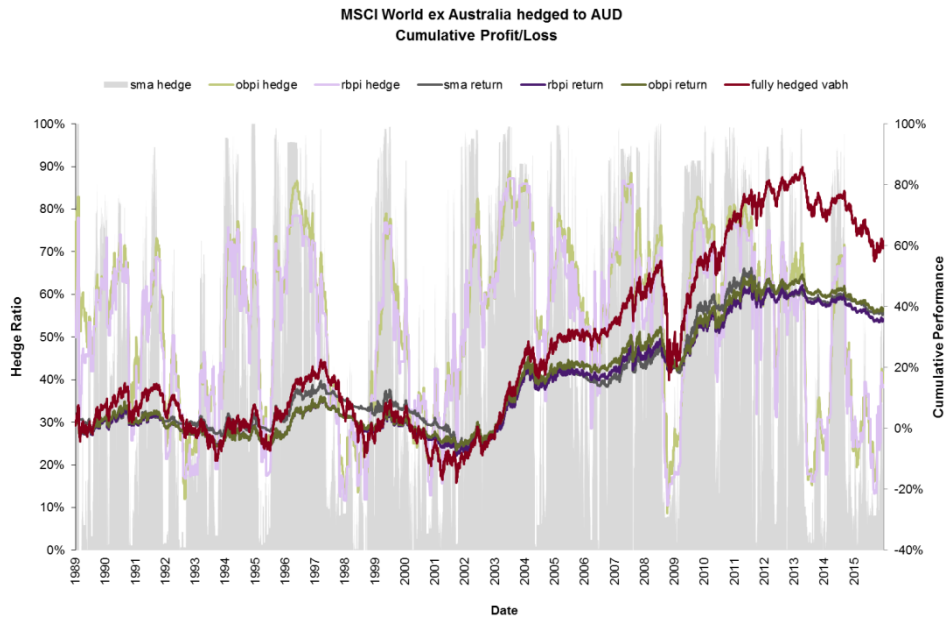
MSCI World ex Australia hedged to AUD
Cumulative Profit/Loss

Figure 17 – Profit/loss payoff from hedging MSCI World ex AUD exposure to AUD

MSCI World ex Australia hedged to AUD
Payoff - Rolling 1 Year Profit/Loss
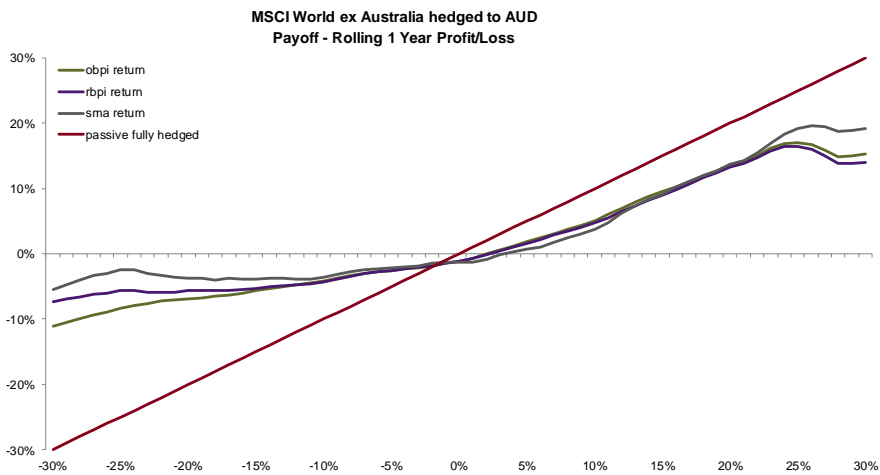
Table 10 – Annual absolute/relative return for MSCI World ex AUD exposure to AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	7.52%	2.87%	9.57%	3.41%	2.80%	2.96%	4.99%	-0.65%	-1.09%	-0.87%
1990	-1.78%	6.65%	0.06%	-1.25%	-1.31%	-0.38%	1.15%	-0.29%	-0.38%	0.53%
1991	-0.44%	2.29%	3.80%	-1.48%	-0.82%	-0.21%	4.07%	-1.24%	-0.60%	0.02%
1992	-5.39%	0.12%	0.45%	-2.21%	-2.41%	-0.68%	3.73%	0.70%	0.38%	2.07%
1993	-1.73%	0.00%	2.00%	-1.94%	-1.61%	-1.84%	3.06%	-1.00%	-0.71%	-0.95%
1994	8.81%	5.52%	5.69%	3.80%	3.81%	4.11%	0.33%	-0.95%	-0.74%	-0.38%
1995	-2.26%	1.26%	3.52%	-2.39%	-2.51%	-1.54%	4.90%	-1.17%	-1.33%	-0.38%
1996	13.22%	13.51%	12.81%	9.84%	9.71%	9.69%	4.77%	2.72%	2.88%	2.95%
1997	-13.40%	3.87%	0.14%	-4.27%	-3.92%	-2.95%	8.29%	2.95%	3.01%	3.88%
1998	-8.77%	0.00%	-1.76%	-3.88%	-4.93%	-4.81%	3.58%	0.85%	-0.40%	-0.34%
1999	9.63%	4.65%	7.22%	3.36%	3.70%	3.36%	1.36%	-1.83%	-1.28%	-1.55%
2000	-11.67%	0.64%	0.06%	-4.98%	-5.53%	-5.65%	7.16%	1.31%	0.50%	0.30%
2001	-3.87%	0.08%	0.86%	-3.05%	-3.94%	-8.04%	3.22%	-0.96%	-1.94%	-6.07%
2002	6.80%	6.04%	6.65%	3.56%	3.76%	3.30%	2.52%	-0.10%	0.25%	-0.17%
2003	26.69%	15.88%	26.69%	20.46%	20.37%	21.43%	10.46%	6.08%	6.57%	7.82%
2004	4.85%	12.21%	4.85%	0.94%	0.39%	0.35%	1.90%	-1.67%	-2.11%	-2.12%
2005	1.67%	6.95%	1.97%	0.37%	-0.02%	-2.13%	0.96%	-0.53%	-0.88%	-2.98%
2006	5.39%	1.55%	5.50%	1.95%	1.83%	-0.01%	2.22%	-0.96%	-0.96%	-2.76%
2007	9.12%	9.89%	9.37%	4.70%	4.22%	3.71%	3.83%	-0.22%	-0.49%	-0.95%
2008	-16.13%	6.83%	2.56%	-5.66%	-3.04%	1.10%	12.37%	3.03%	5.29%	9.32%
2009	26.18%	8.11%	21.99%	13.86%	12.95%	17.23%	6.07%	-0.24%	-0.58%	3.88%
2010	16.82%	18.71%	16.82%	10.33%	9.24%	10.59%	6.59%	1.27%	0.55%	2.01%
2011	4.70%	13.05%	4.66%	0.27%	-0.05%	-4.78%	1.79%	-2.26%	-2.48%	-7.18%
2012	5.13%	6.19%	4.68%	1.74%	1.38%	-1.27%	1.56%	-1.03%	-1.27%	-3.89%
2013	-10.88%	1.87%	-0.18%	-3.97%	-3.43%	-1.82%	6.43%	1.89%	2.19%	3.72%
2014	-2.00%	1.02%	1.71%	-1.34%	-1.36%	0.02%	2.92%	-0.26%	-0.33%	1.05%
2015	-6.76%	0.00%	0.00%	-2.87%	-3.38%	-3.84%	4.11%	0.77%	0.11%	-0.39%

Table 11 – Summary statistics for absolute/relative return for MSCI World ex AUD exposure to AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	2.27%	5.53%	5.60%	1.45%	1.33%	1.40%	4.22%	0.23%	0.15%	0.24%
Median	2.85%	2.85%	3.96%	0.50%	0.42%	0.17%				
Skew	0.07	1.52	1.18	0.90	0.98	1.28				
Volatility	11.11%	0.43%	7.13%	5.64%	5.35%	5.66%	4.19%	2.86%	2.87%	4.05%
Negative Semi-deviation			8.04%	6.24%	5.91%	6.11%				
Average drawdown			-2.07%	-6.62%	-6.47%	-6.92%				
Maximum drawdown			-12.07%	-17.75%	-19.29%	-22.70%				
% Positive Years	54%	92%	83%	53%	53%	52%	97%	50%	46%	53%
Average Hedge Ratio	100%			54%	52%	51%				
Information Ratio	0.20	12.84	0.79	0.26	0.25	0.25	1.01	0.08	0.05	0.06
Sortino Ratio				0.23	0.22	0.23				
Calmar Ratio				0.08	0.07	0.06				
Average Rolling 1yr Return (Relative to free option)				-4.05%	-4.16%	-4.08%				
Negative Semi-deviation (Relative to free option)				4.76%	4.95%	5.36%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-4.12%	-4.23%	-4.15%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.65%	4.70%	4.85%				
Turnover				1.35	1.37	9.62				
Trade Size (5th Pctile)				0.08%	0.05%	0.45%				
Trade Size (20th Pctile)				0.19%	0.44%	1.26%				
Trade Size (50th Pctile)				0.52%	1.72%	3.67%				
Trade Size (Average)				1.05%	2.84%	7.00%				
Trade Size (80th Pctile)				1.61%	4.28%	11.74%				
Trade Size (95th Pctile)				3.56%	10.47%	23.43%				
Trade Size (99th Pctile)				5.75%	14.23%	36.78%				

Figure 18 – Cumulative profit/loss from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Cumulative Profit/Loss
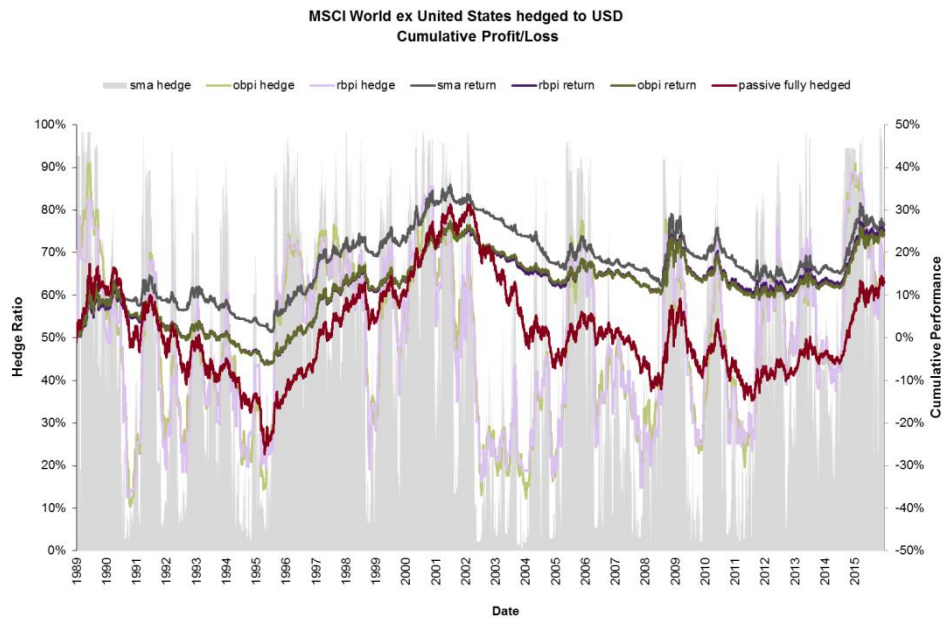
Figure 19 – Profit/loss payoff from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Payoff - Rolling 1 Year Profit/Loss
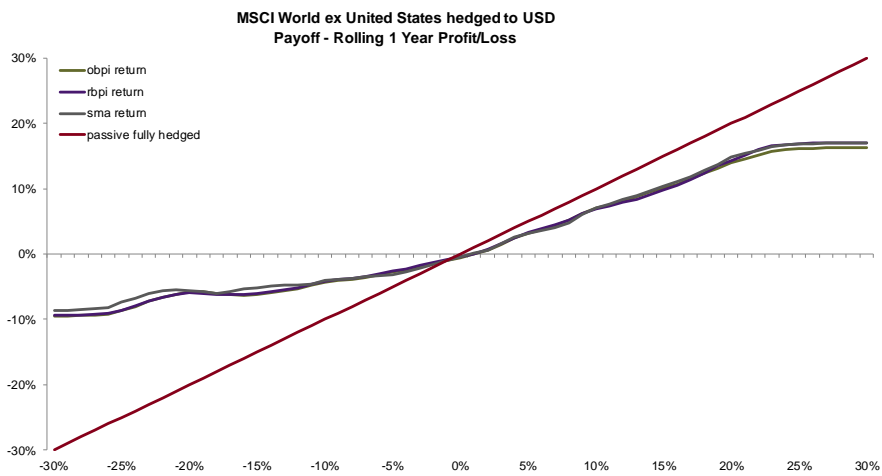
Table 12 – Annual absolute/relative return for MSCI World ex USD exposure to USD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	10.79%	9.76%	12.13%	7.89%	7.01%	8.12%	6.66%	2.52%	1.69%	2.85%
1990	-9.24%	3.24%	1.15%	-2.35%	-2.03%	0.81%	5.84%	2.25%	2.53%	5.33%
1991	-5.68%	0.43%	0.12%	-3.84%	-2.85%	-0.12%	3.00%	-1.01%	-0.05%	2.66%
1992	3.39%	0.13%	1.24%	1.20%	0.82%	2.36%	-0.48%	-0.49%	-0.85%	0.70%
1993	-4.28%	0.30%	-0.65%	-1.74%	-1.66%	-2.50%	1.52%	0.39%	0.45%	-0.41%
1994	-9.14%	0.00%	0.27%	-4.57%	-4.48%	-4.67%	4.91%	-0.02%	0.03%	-0.20%
1995	0.76%	0.20%	5.06%	1.48%	1.07%	2.67%	4.67%	1.11%	0.70%	2.29%
1996	8.22%	10.04%	8.22%	6.81%	6.79%	7.30%	4.05%	2.72%	2.74%	3.29%
1997	12.93%	11.06%	12.66%	8.84%	8.74%	8.05%	6.11%	2.40%	2.36%	1.73%
1998	-3.83%	5.89%	-1.82%	-2.47%	-2.55%	-2.79%	0.12%	-0.56%	-0.66%	-0.92%
1999	6.97%	2.09%	6.03%	3.11%	3.29%	4.60%	2.50%	-0.36%	-0.15%	1.19%
2000	10.75%	9.35%	10.77%	6.63%	7.18%	7.51%	5.32%	1.28%	1.88%	2.26%
2001	7.07%	7.81%	6.42%	3.98%	3.37%	0.85%	2.83%	0.46%	-0.11%	-2.60%
2002	-12.86%	1.47%	0.30%	-4.65%	-4.85%	-4.14%	6.82%	1.75%	1.49%	2.14%
2003	-15.66%	0.00%	0.00%	-4.17%	-4.55%	-4.19%	7.94%	3.63%	3.17%	3.46%
2004	-7.37%	0.00%	-1.87%	-3.40%	-3.19%	-6.41%	1.86%	0.27%	0.44%	-2.81%
2005	12.64%	2.18%	8.57%	5.23%	5.83%	5.55%	2.16%	-1.06%	-0.41%	-0.63%
2006	-4.99%	3.00%	-1.41%	-3.11%	-2.81%	-5.32%	1.12%	-0.63%	-0.35%	-2.88%
2007	-6.35%	0.04%	-0.13%	-2.57%	-2.82%	-1.89%	3.08%	0.58%	0.31%	1.21%
2008	7.21%	2.38%	9.25%	6.64%	7.03%	8.51%	5.59%	3.05%	3.48%	4.99%
2009	-6.51%	7.08%	-0.24%	-4.91%	-4.96%	-5.22%	3.06%	-1.66%	-1.75%	-2.04%
2010	-2.70%	0.92%	1.42%	-2.00%	-1.52%	-1.47%	2.79%	-0.56%	-0.19%	-0.14%
2011	0.02%	0.01%	2.81%	-0.93%	-0.81%	-1.77%	2.79%	-0.94%	-0.82%	-1.78%
2012	-0.13%	2.99%	0.09%	-0.77%	-0.70%	-1.87%	0.16%	-0.70%	-0.64%	-1.81%
2013	3.75%	3.93%	4.47%	2.42%	2.24%	2.73%	2.57%	0.55%	0.39%	0.89%
2014	10.28%	2.61%	10.60%	7.30%	7.37%	8.22%	5.39%	2.18%	2.30%	3.20%
2015	7.51%	13.10%	7.51%	4.47%	4.51%	2.02%	3.70%	0.73%	0.81%	-1.65%

Table 13 – Summary statistics for absolute/relative return for MSCI World ex USD exposure to USD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	0.50%	3.69%	3.80%	0.91%	0.94%	0.99%	3.55%	0.66%	0.69%	0.75%
Median	0.19%	0.19%	1.92%	-0.26%	-0.16%	0.44%				
Skew	(0.01)	1.12	0.87	0.53	0.55	0.47				
Volatility	7.69%	0.31%	4.65%	4.37%	4.32%	4.80%	2.72%	1.94%	1.93%	2.86%
Negative Semi-deviation			4.91%	4.55%	4.48%	4.94%				
Average drawdown			-2.42%	-9.67%	-9.02%	-10.42%				
Maximum drawdown			-7.57%	-19.52%	-17.98%	-23.80%				
% Positive Years	50%	88%	71%	47%	48%	54%	98%	64%	66%	62%
Average Hedge Ratio	100%			50%	49%	49%				
Information Ratio	0.07	12.00	0.82	0.21	0.22	0.21	1.30	0.34	0.36	0.26
Sortino Ratio				0.20	0.21	0.20				
Calmar Ratio				0.05	0.05	0.04				
Average Rolling 1yr Return (Relative to free option)				-2.83%	-2.79%	-2.69%				
Negative Semi-deviation (Relative to free option)				3.44%	3.41%	3.76%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.83%	-2.80%	-2.69%				
Negative Semi-deviation (Relative to investable perfect hedge)				3.20%	3.16%	3.36%				
Turnover				1.18	1.17	8.52				
Trade Size (5th Pctile)				0.09%	0.05%	0.50%				
Trade Size (20th Pctile)				0.20%	0.44%	1.49%				
Trade Size (50th Pctile)				0.55%	1.54%	4.40%				
Trade Size (Average)				0.84%	2.59%	6.07%				
Trade Size (80th Pctile)				1.27%	4.25%	9.53%				
Trade Size (95th Pctile)				2.54%	7.70%	17.33%				
Trade Size (99th Pctile)				4.19%	10.75%	27.55%				

Adding the rebalancing discipline feature to each strategy appears to reduce turnover significantly in both cases. However this turnover reduction appears to be directly related to the magnitude of risk-adjusted returns. For the Australian dollar base where any hedging has been rewarded with positive return in this sample, reduced turnover has marginally lowered the positive return and risk-adjusted return statistics in absolute and relative terms. For the US dollar base where any hedging has been associated with a negative return over this sample, reduced turnover has marginally increased return by reducing the magnitude of the negative return.

We note again, that the full advantage of the RBPI rebalancing discipline over the OBPI discipline is not obvious in a simple comparison of momentum strategies. The OBPI rebalancing discipline is specific to the OBPI signal and not a generic turnover constraint. Live accounts running RPBI-Momentum have a single 15% minimum trade constraint applied to the net position (net of signals and constraints) at implementation. Live accounts running OBPI have these hysteresis trading bands in the signal and another set of trading bands in the constraint and then a different minimum trade

INSIGHT INVESTMENT

at the point of implementation. That makes no sense if there is no market timing edge in each of those applications.

If trading bands are just a rebalancing discipline whose sole objective is to reduce turnover for no net cost then they should be applied to the net trade for each account and are entirely separate from the signal.

3.1.4   Time to expiry function

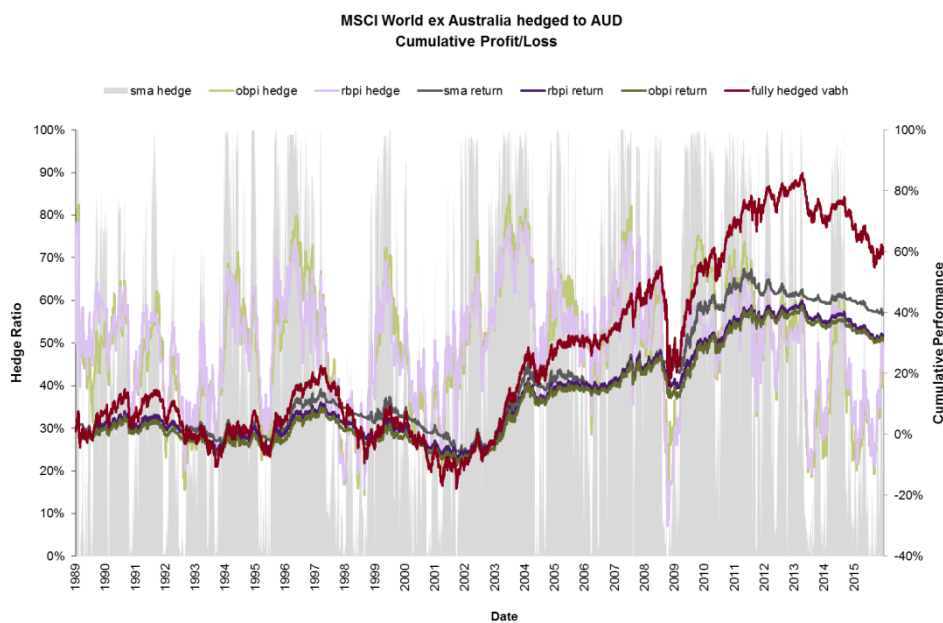Figure 20 – Cumulative profit/loss from hedging MSCI World ex AUD exposure to AUD

Figure 21 – Profit/loss payoff from hedging MSCI World ex AUD exposure to AUD
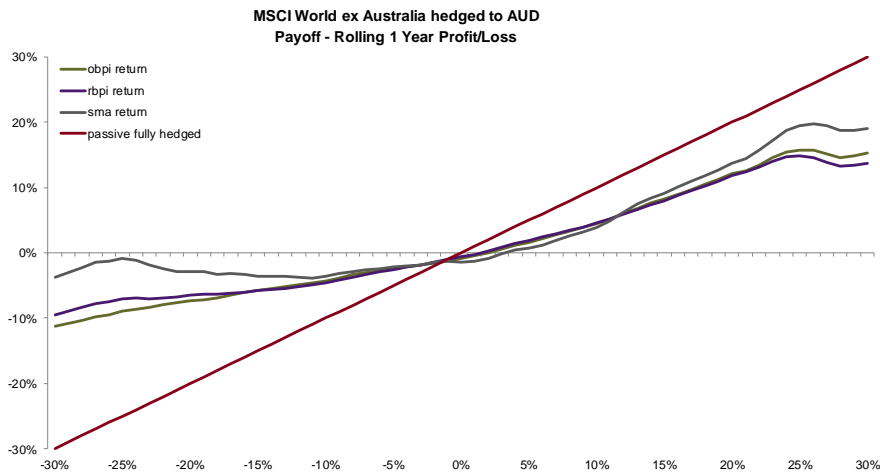
Table 14 – Annual absolute/relative return for MSCI World ex AUD exposure to AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	7.52%	2.87%	9.57%	1.96%	3.53%	2.88%	4.99%	-1.76%	-0.21%	-0.98%
1990	-1.78%	6.65%	0.06%	-1.10%	-1.07%	-0.00%	1.15%	-0.22%	-0.18%	0.92%
1991	-0.44%	2.29%	3.80%	-0.92%	-0.23%	-0.37%	4.07%	-0.70%	-0.01%	-0.15%
1992	-5.39%	0.12%	0.45%	-1.89%	-2.68%	-0.72%	3.73%	0.78%	-0.00%	2.05%
1993	-1.73%	0.00%	2.00%	-1.59%	-1.70%	-2.28%	3.06%	-0.73%	-0.84%	-1.39%
1994	8.81%	5.52%	5.69%	3.39%	4.24%	3.55%	0.33%	-0.97%	-0.14%	-0.98%
1995	-2.26%	1.26%	3.52%	-1.68%	-1.70%	-1.79%	4.90%	-0.56%	-0.58%	-0.63%
1996	13.22%	13.51%	12.81%	8.26%	7.44%	9.97%	4.77%	1.71%	0.88%	3.18%
1997	-13.40%	3.87%	0.14%	-5.12%	-4.49%	-2.50%	8.29%	1.52%	2.16%	4.38%
1998	-8.77%	0.00%	-1.76%	-4.54%	-4.70%	-5.06%	3.58%	-0.19%	-0.35%	-0.56%
1999	9.63%	4.65%	7.22%	3.54%	3.94%	3.72%	1.36%	-1.23%	-0.84%	-1.23%
2000	-11.67%	0.64%	0.06%	-5.20%	-5.68%	-5.86%	7.16%	0.58%	0.11%	0.13%
2001	-3.87%	0.08%	0.86%	-3.02%	-3.43%	-7.81%	3.22%	-1.10%	-1.51%	-5.82%
2002	6.80%	6.04%	6.65%	2.92%	3.10%	3.20%	2.52%	-0.45%	-0.28%	-0.29%
2003	26.69%	15.88%	26.69%	18.46%	18.04%	22.11%	10.46%	5.24%	4.79%	8.39%
2004	4.85%	12.21%	4.85%	0.84%	1.18%	0.31%	1.90%	-1.56%	-1.23%	-2.19%
2005	1.67%	6.95%	1.97%	0.17%	0.16%	-2.02%	0.96%	-0.66%	-0.67%	-2.88%
2006	5.39%	1.55%	5.50%	2.02%	2.02%	-0.28%	2.22%	-0.65%	-0.66%	-3.05%
2007	9.12%	9.89%	9.37%	3.95%	3.71%	4.12%	3.83%	-0.57%	-0.82%	-0.57%
2008	-16.13%	6.83%	2.56%	-5.88%	-4.28%	2.53%	12.37%	2.10%	3.72%	10.81%
2009	26.18%	8.11%	21.99%	13.58%	12.58%	17.20%	6.07%	0.62%	-0.40%	3.75%
2010	16.82%	18.71%	16.82%	9.07%	8.82%	10.43%	6.59%	0.75%	0.48%	1.78%
2011	4.70%	13.05%	4.66%	0.54%	0.22%	-4.68%	1.79%	-1.79%	-2.11%	-7.09%
2012	5.13%	6.19%	4.68%	1.72%	2.29%	-1.32%	1.56%	-0.82%	-0.25%	-3.95%
2013	-10.88%	1.87%	-0.18%	-3.99%	-4.42%	-1.84%	6.43%	1.39%	0.98%	3.75%
2014	-2.00%	1.02%	1.71%	-1.22%	-1.03%	0.34%	2.92%	-0.23%	-0.03%	1.37%
2015	-6.76%	0.00%	0.00%	-2.68%	-3.24%	-3.95%	4.11%	0.67%	0.12%	-0.47%

Table 15 – Summary statistics for absolute/relative return for MSCI World ex AUD exposure to AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	2.27%	5.53%	5.60%	1.17%	1.20%	1.47%	4.22%	0.04%	0.08%	0.31%
Median	2.85%	2.85%	3.96%	0.50%	0.78%	0.30%				
Skew	0.07	1.52	1.18	0.83	0.69	1.28				
Volatility	11.11%	0.43%	7.13%	5.18%	5.07%	5.69%	4.19%	2.10%	2.25%	4.27%
Negative Semi-deviation			8.04%	5.71%	5.58%	6.11%				
Average drawdown			-2.07%	-6.29%	-5.91%	-6.89%				
Maximum drawdown			-12.07%	-19.39%	-19.34%	-21.95%				
% Positive Years	54%	92%	83%	54%	56%	53%	97%	45%	44%	52%
Average Hedge Ratio	100%			50%	50%	51%				
Information Ratio	0.20	12.84	0.79	0.23	0.24	0.26	1.01	0.02	0.03	0.07
Sortino Ratio				0.20	0.22	0.24				
Calmar Ratio				0.06	0.06	0.07				
Average Rolling 1yr Return (Relative to free option)				-4.34%	-4.29%	-4.00%				
Negative Semi-deviation (Relative to free option)				5.10%	5.15%	5.33%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-4.41%	-4.37%	-4.07%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.96%	4.91%	4.80%				
Turnover				1.69	1.77	12.62				
Trade Size (5th Pctile)				0.12%	0.11%	0.25%				
Trade Size (20th Pctile)				0.25%	0.26%	0.95%				
Trade Size (50th Pctile)				0.86%	0.92%	3.42%				
Trade Size (Average)				1.60%	1.66%	5.82%				
Trade Size (80th Pctile)				2.80%	2.91%	9.41%				
Trade Size (95th Pctile)				5.03%	5.23%	19.42%				
Trade Size (99th Pctile)				7.26%	7.87%	34.31%				

Figure 22 – Cumulative profit/loss from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Cumulative Profit/Loss
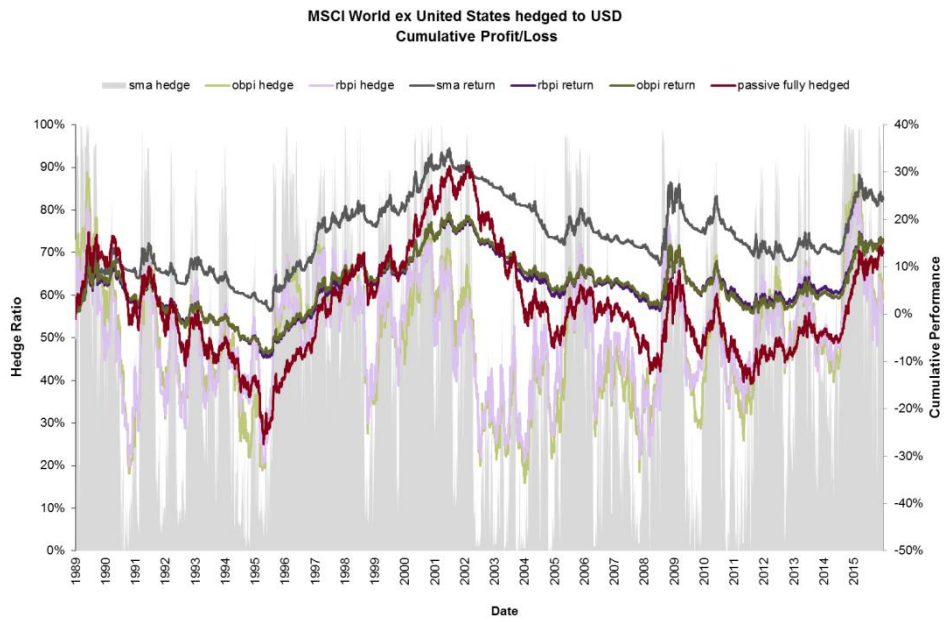
Figure 23 – Profit/loss payoff from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Payoff - Rolling 1 Year Profit/Loss

INSIGHT INVESTMENT
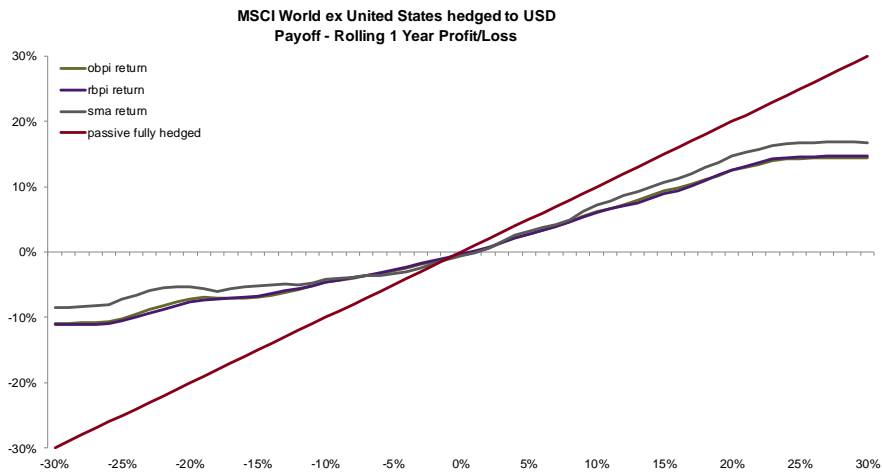
Table 16 – Annual absolute/relative return for MSCI World ex USD exposure to USD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	10.79%	9.76%	12.13%	7.04%	6.45%	8.64%	6.66%	1.65%	1.01%	3.35%
1990	-9.24%	3.24%	1.15%	-3.24%	-3.21%	0.52%	5.84%	1.37%	1.45%	5.05%
1991	-5.68%	0.43%	0.12%	-3.75%	-2.57%	-0.35%	3.00%	-0.91%	0.30%	2.44%
1992	3.39%	0.13%	1.24%	1.54%	1.06%	2.32%	-0.48%	-0.15%	-0.65%	0.66%
1993	-4.28%	0.30%	-0.65%	-1.86%	-1.86%	-2.50%	1.52%	0.27%	0.30%	-0.40%
1994	-9.14%	0.00%	0.27%	-4.88%	-5.01%	-4.83%	4.91%	-0.32%	-0.40%	-0.34%
1995	0.76%	0.20%	5.06%	1.40%	1.04%	2.12%	4.67%	1.02%	0.66%	1.75%
1996	8.22%	10.04%	8.22%	5.48%	4.91%	7.39%	4.05%	1.38%	0.76%	3.36%
1997	12.93%	11.06%	12.66%	7.60%	7.71%	8.02%	6.11%	1.15%	1.19%	1.67%
1998	-3.83%	5.89%	-1.82%	-2.36%	-2.25%	-2.69%	0.12%	-0.44%	-0.32%	-0.81%
1999	6.97%	2.09%	6.03%	3.02%	3.08%	4.46%	2.50%	-0.46%	-0.43%	1.04%
2000	10.75%	9.35%	10.77%	5.74%	6.44%	7.58%	5.32%	0.37%	1.03%	2.31%
2001	7.07%	7.81%	6.42%	3.66%	3.09%	0.14%	2.83%	0.13%	-0.48%	-3.33%
2002	-12.86%	1.47%	0.30%	-5.32%	-5.57%	-3.95%	6.82%	1.10%	0.91%	2.35%
2003	-15.66%	0.00%	0.00%	-5.21%	-5.62%	-3.98%	7.94%	2.61%	2.28%	3.70%
2004	-7.37%	0.00%	-1.87%	-3.97%	-4.04%	-6.86%	1.86%	-0.30%	-0.32%	-3.25%
2005	12.64%	2.18%	8.57%	4.99%	5.91%	5.32%	2.16%	-1.33%	-0.46%	-0.88%
2006	-4.99%	3.00%	-1.41%	-3.02%	-3.30%	-5.48%	1.12%	-0.53%	-0.78%	-3.03%
2007	-6.35%	0.04%	-0.13%	-2.81%	-3.14%	-1.76%	3.08%	0.36%	0.06%	1.35%
2008	7.21%	2.38%	9.25%	6.21%	6.76%	8.95%	5.59%	2.61%	3.13%	5.41%
2009	-6.51%	7.08%	-0.24%	-4.81%	-4.22%	-5.27%	3.06%	-1.56%	-0.94%	-2.08%
2010	-2.70%	0.92%	1.42%	-1.99%	-1.36%	-0.98%	2.79%	-0.64%	0.00%	0.35%
2011	0.02%	0.01%	2.81%	-0.75%	-0.86%	-2.45%	2.79%	-0.77%	-0.88%	-2.47%
2012	-0.13%	2.99%	0.09%	-0.70%	-0.40%	-2.23%	0.16%	-0.63%	-0.33%	-2.16%
2013	3.75%	3.93%	4.47%	2.41%	2.34%	2.40%	2.57%	0.54%	0.44%	0.56%
2014	10.28%	2.61%	10.60%	6.85%	6.32%	8.30%	5.39%	1.71%	1.14%	3.26%
2015	7.51%	13.10%	7.51%	4.33%	4.02%	1.93%	3.70%	0.58%	0.23%	-1.76%

Table 17 – Summary statistics for absolute/relative return for MSCI World ex USD exposure to USD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	0.50%	3.69%	3.80%	0.57%	0.58%	0.91%	3.55%	0.32%	0.33%	0.67%
Median	0.19%	0.19%	1.92%	-0.21%	-0.08%	0.22%				
Skew	(0.01)	1.12	0.87	0.41	0.35	0.53				
Volatility	7.69%	0.31%	4.65%	4.22%	4.21%	4.85%	2.72%	1.55%	1.41%	2.91%
Negative Semi-deviation			4.91%	4.38%	4.37%	4.97%				
Average drawdown			-2.42%	-11.16%	-10.52%	-10.82%				
Maximum drawdown			-7.57%	-21.30%	-20.51%	-24.67%				
% Positive Years	50%	88%	71%	48%	49%	52%	98%	56%	61%	59%
Average Hedge Ratio	100%			50%	50%	49%				
Information Ratio	0.07	12.00	0.82	0.14	0.14	0.19	1.30	0.21	0.23	0.23
Sortino Ratio				0.13	0.13	0.18				
Calmar Ratio				0.03	0.03	0.04				
Average Rolling 1yr Return (Relative to free option)				-3.16%	-3.15%	-2.76%				
Negative Semi-deviation (Relative to free option)				3.77%	3.78%	3.86%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-3.16%	-3.16%	-2.77%				
Negative Semi-deviation (Relative to investable perfect hedge)				3.54%	3.52%	3.44%				
Turnover				1.53	1.62	11.16				
Trade Size (5th Pctile)				0.13%	0.13%	0.32%				
Trade Size (20th Pctile)				0.36%	0.36%	1.06%				
Trade Size (50th Pctile)				1.09%	1.13%	3.23%				
Trade Size (Average)				1.37%	1.43%	5.01%				
Trade Size (80th Pctile)				2.12%	2.22%	7.95%				
Trade Size (95th Pctile)				3.92%	4.09%	15.49%				
Trade Size (99th Pctile)				5.91%	6.39%	24.65%				

The "time to expiry function" feature involves using a constant time scaling function with a margin floor for RBPI while only a constant time scaling function for OBPI. Note that, as per Figure 1, this is not a feature of the OBPI-Momentum strategy itself but is included here as a matter of interest.

This feature seems to reduce risk-adjusted return for the strategy and increase its deviation from the "free option". This is also associated with a significant drop in turnover as the average gamma of the underlying book of "options" for the strategy is reduced. This should be expected based on the effect this has on the RBPI multiplier illustrated in Figure 2 earlier. This constant time to expiry feature for RBPI means a much more constant multiplier and consequently, less hedge ratio volatility.

The margin floor we associate with this feature further acts to reinforce this reduction in hedge ratio volatility, resulting in more constant exposure to the return available from hedging. Running these strategies with this constant time to expiry achieves the "benchmark" position, or the buy-and-hold return associated with the neutral 50% hedged position as is evident in the summary statistics for the return relative to the average hedge in Table 17.

Interestingly, this suggests that most the momentum strategies active "skill" is a function of increased variability in the hedge ratio – generally high gamma at initiation and increased resetting frequency mean the strategy can quickly take exposure to trends and take profits frequently by resetting. Resetting is, in effect, like constant-weight rebalancing (AKA count-trend).

3.1.5   Delta adjustment

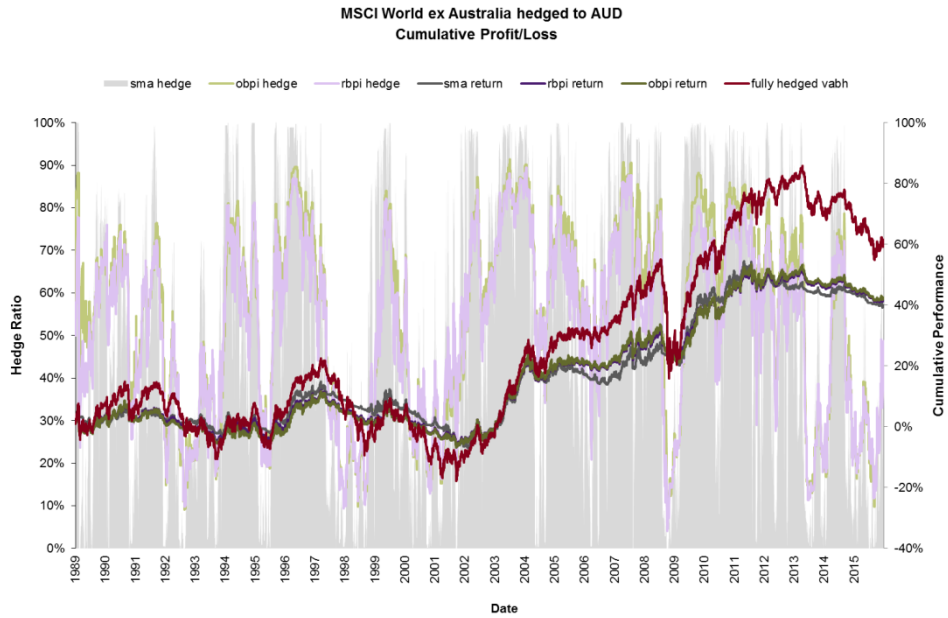Figure 24 – Cumulative profit/loss from hedging MSCI World ex AUD exposure to AUD

Figure 25 – Profit/loss payoff from hedging MSCI World ex AUD exposure to AUD
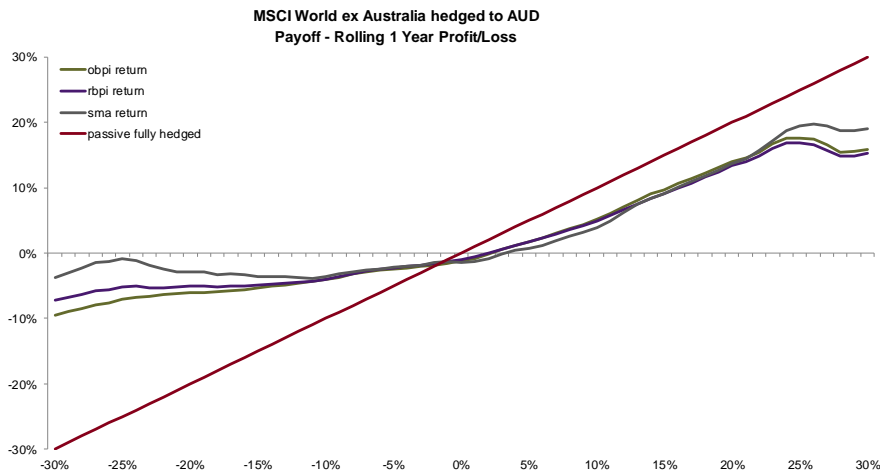
Table 18 – Annual absolute/relative return for MSCI World ex AUD exposure to AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	7.52%	2.87%	9.57%	3.01%	3.29%	2.88%	4.99%	-1.10%	-0.63%	-0.98%
1990	-1.78%	6.65%	0.06%	-0.76%	-0.67%	-0.00%	1.15%	0.21%	0.26%	0.92%
1991	-0.44%	2.29%	3.80%	-1.22%	-0.65%	-0.37%	4.07%	-0.98%	-0.42%	-0.15%
1992	-5.39%	0.12%	0.45%	-2.01%	-2.14%	-0.72%	3.73%	0.93%	0.67%	2.05%
1993	-1.73%	0.00%	2.00%	-2.19%	-2.10%	-2.28%	3.06%	-1.25%	-1.20%	-1.39%
1994	8.81%	5.52%	5.69%	3.92%	4.42%	3.55%	0.33%	-0.90%	-0.18%	-0.98%
1995	-2.26%	1.26%	3.52%	-2.39%	-2.54%	-1.79%	4.90%	-1.15%	-1.36%	-0.63%
1996	13.22%	13.51%	12.81%	10.35%	9.46%	9.97%	4.77%	3.13%	2.57%	3.18%
1997	-13.40%	3.87%	0.14%	-4.17%	-3.97%	-2.50%	8.29%	3.16%	3.01%	4.38%
1998	-8.77%	0.00%	-1.76%	-4.00%	-4.01%	-5.06%	3.58%	0.80%	0.56%	-0.56%
1999	9.63%	4.65%	7.22%	2.96%	3.02%	3.72%	1.36%	-2.30%	-2.00%	-1.23%
2000	-11.67%	0.64%	0.06%	-5.10%	-5.42%	-5.86%	7.16%	1.27%	0.66%	0.13%
2001	-3.87%	0.08%	0.86%	-3.35%	-3.34%	-7.81%	3.22%	-1.23%	-1.32%	-5.82%
2002	6.80%	6.04%	6.65%	3.64%	3.46%	3.20%	2.52%	-0.07%	-0.08%	-0.29%
2003	26.69%	15.88%	26.69%	21.06%	20.58%	22.11%	10.46%	6.48%	6.67%	8.39%
2004	4.85%	12.21%	4.85%	0.95%	1.14%	0.31%	1.90%	-1.70%	-1.38%	-2.19%
2005	1.67%	6.95%	1.97%	0.21%	-0.08%	-2.02%	0.96%	-0.70%	-0.95%	-2.88%
2006	5.39%	1.55%	5.50%	1.55%	1.49%	-0.28%	2.22%	-1.40%	-1.32%	-3.05%
2007	9.12%	9.89%	9.37%	4.83%	4.48%	4.12%	3.83%	-0.15%	-0.28%	-0.57%
2008	-16.13%	6.83%	2.56%	-4.35%	-2.57%	2.53%	12.37%	4.46%	5.83%	10.81%
2009	26.18%	8.11%	21.99%	14.62%	13.98%	17.20%	6.07%	0.31%	0.34%	3.75%
2010	16.82%	18.71%	16.82%	10.64%	9.81%	10.43%	6.59%	1.45%	1.05%	1.78%
2011	4.70%	13.05%	4.66%	0.20%	0.02%	-4.68%	1.79%	-2.37%	-2.43%	-7.09%
2012	5.13%	6.19%	4.68%	1.55%	1.51%	-1.32%	1.56%	-1.26%	-1.17%	-3.95%
2013	-10.88%	1.87%	-0.18%	-3.25%	-3.16%	-1.84%	6.43%	2.70%	2.51%	3.75%
2014	-2.00%	1.02%	1.71%	-1.34%	-1.06%	0.34%	2.92%	-0.25%	-0.02%	1.37%
2015	-6.76%	0.00%	0.00%	-2.87%	-3.02%	-3.95%	4.11%	0.82%	0.50%	-0.47%

Table 19 – Annual absolute/relative return for MSCI World ex AUD exposure to AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	2.27%	5.53%	5.60%	1.57%	1.55%	1.47%	4.22%	0.33%	0.37%	0.31%
Median	2.85%	2.85%	3.96%	0.48%	0.55%	0.30%				
Skew	0.07	1.52	1.18	1.00	1.03	1.28				
Volatility	11.11%	0.43%	7.13%	5.72%	5.36%	5.69%	4.19%	3.18%	3.02%	4.27%
Negative Semi-deviation			8.04%	6.31%	5.89%	6.11%				
Average drawdown			-2.07%	-6.67%	-6.09%	-6.89%				
Maximum drawdown			-12.07%	-18.59%	-18.53%	-21.95%				
% Positive Years	54%	92%	83%	53%	53%	53%	97%	51%	50%	52%
Average Hedge Ratio	100%			55%	52%	51%				
Information Ratio	0.20	12.84	0.79	0.27	0.29	0.26	1.01	0.10	0.12	0.07
Sortino Ratio				0.25	0.26	0.24				
Calmar Ratio				0.08	0.08	0.07				
Average Rolling 1yr Return (Relative to free option)				-3.92%	-3.94%	-4.00%				
Negative Semi-deviation (Relative to free option)				4.63%	4.72%	5.33%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-4.00%	-4.01%	-4.07%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.47%	4.44%	4.80%				
Turnover				2.76	2.91	12.62				
Trade Size (5th Pctile)				0.17%	0.16%	0.25%				
Trade Size (20th Pctile)				0.34%	0.35%	0.95%				
Trade Size (50th Pctile)				1.05%	1.08%	3.42%				
Trade Size (Average)				1.95%	2.01%	5.82%				
Trade Size (80th Pctile)				3.29%	3.46%	9.41%				
Trade Size (95th Pctile)				6.25%	6.15%	19.42%				
Trade Size (99th Pctile)				9.05%	9.18%	34.31%				

Figure 26 – Cumulative profit/loss from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Cumulative Profit/Loss
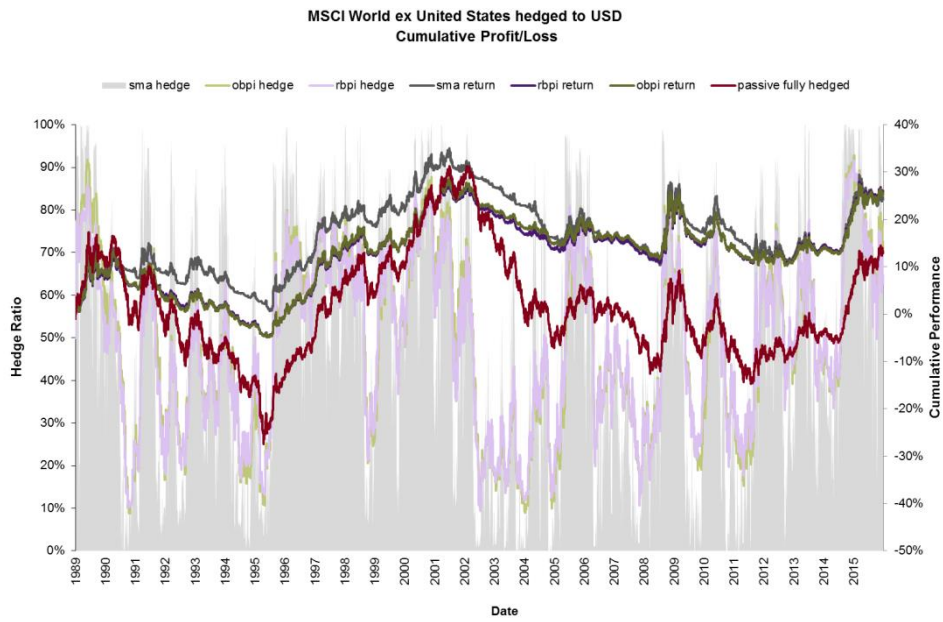
Figure 27 – Profit/loss payoff from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Payoff - Rolling 1 Year Profit/Loss
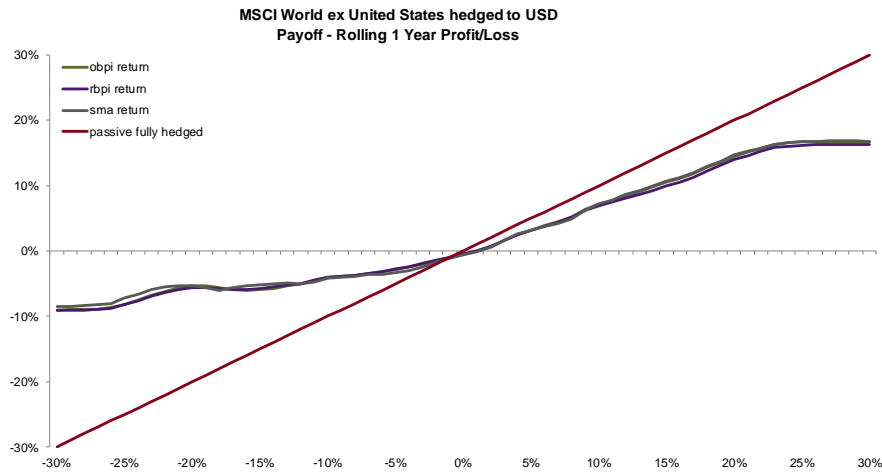
Table 20 – Annual absolute/relative return for MSCI World ex USD exposure to USD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	10.79%	9.76%	12.13%	8.42%	7.85%	8.64%	6.66%	3.06%	2.55%	3.35%
1990	-9.24%	3.24%	1.15%	-1.98%	-1.54%	0.52%	5.84%	2.61%	2.99%	5.05%
1991	-5.68%	0.43%	0.12%	-3.55%	-2.75%	-0.35%	3.00%	-0.72%	0.04%	2.44%
1992	3.39%	0.13%	1.24%	1.16%	0.81%	2.32%	-0.48%	-0.53%	-0.85%	0.66%
1993	-4.28%	0.30%	-0.65%	-1.84%	-1.95%	-2.50%	1.52%	0.29%	0.15%	-0.40%
1994	-9.14%	0.00%	0.27%	-4.51%	-4.39%	-4.83%	4.91%	0.03%	0.10%	-0.34%
1995	0.76%	0.20%	5.06%	1.76%	1.40%	2.12%	4.67%	1.39%	1.03%	1.75%
1996	8.22%	10.04%	8.22%	6.99%	6.55%	7.39%	4.05%	2.91%	2.52%	3.36%
1997	12.93%	11.06%	12.66%	8.81%	8.73%	8.02%	6.11%	2.39%	2.38%	1.67%
1998	-3.83%	5.89%	-1.82%	-2.44%	-2.28%	-2.69%	0.12%	-0.54%	-0.40%	-0.81%
1999	6.97%	2.09%	6.03%	3.01%	3.24%	4.46%	2.50%	-0.45%	-0.18%	1.04%
2000	10.75%	9.35%	10.77%	6.87%	6.75%	7.58%	5.32%	1.53%	1.48%	2.31%
2001	7.07%	7.81%	6.42%	3.54%	3.13%	0.14%	2.83%	0.03%	-0.34%	-3.33%
2002	-12.86%	1.47%	0.30%	-4.37%	-4.58%	-3.95%	6.82%	2.01%	1.73%	2.35%
2003	-15.66%	0.00%	0.00%	-3.69%	-4.04%	-3.98%	7.94%	4.09%	3.65%	3.70%
2004	-7.37%	0.00%	-1.87%	-3.43%	-3.39%	-6.86%	1.86%	0.22%	0.23%	-3.25%
2005	12.64%	2.18%	8.57%	5.02%	5.48%	5.32%	2.16%	-1.26%	-0.73%	-0.88%
2006	-4.99%	3.00%	-1.41%	-3.36%	-3.30%	-5.48%	1.12%	-0.88%	-0.85%	-3.03%
2007	-6.35%	0.04%	-0.13%	-2.58%	-2.75%	-1.76%	3.08%	0.57%	0.36%	1.35%
2008	7.21%	2.38%	9.25%	6.94%	7.22%	8.95%	5.59%	3.36%	3.69%	5.41%
2009	-6.51%	7.08%	-0.24%	-4.94%	-4.88%	-5.27%	3.06%	-1.71%	-1.68%	-2.08%
2010	-2.70%	0.92%	1.42%	-2.09%	-1.64%	-0.98%	2.79%	-0.75%	-0.31%	0.35%
2011	0.02%	0.01%	2.81%	-1.31%	-1.20%	-2.45%	2.79%	-1.32%	-1.21%	-2.47%
2012	-0.13%	2.99%	0.09%	-1.13%	-0.99%	-2.23%	0.16%	-1.07%	-0.92%	-2.16%
2013	3.75%	3.93%	4.47%	2.57%	2.70%	2.40%	2.57%	0.70%	0.86%	0.56%
2014	10.28%	2.61%	10.60%	7.48%	7.51%	8.30%	5.39%	2.37%	2.46%	3.26%
2015	7.51%	13.10%	7.51%	4.31%	4.34%	1.93%	3.70%	0.58%	0.66%	-1.76%

Table 21 – Summary statistics for absolute/relative return for MSCI World ex USD exposure to USD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	0.50%	3.69%	3.80%	0.95%	0.96%	0.91%	3.55%	0.70%	0.72%	0.67%
Median	0.19%	0.19%	1.92%	-0.32%	-0.21%	0.22%				
Skew	(0.01)	1.12	0.87	0.58	0.56	0.53				
Volatility	7.69%	0.31%	4.65%	4.45%	4.33%	4.85%	2.72%	2.11%	2.00%	2.91%
Negative Semi-deviation			4.91%	4.63%	4.49%	4.97%				
Average drawdown			-2.42%	-9.50%	-8.97%	-10.82%				
Maximum drawdown			-7.57%	-18.73%	-17.67%	-24.67%				
% Positive Years	50%	88%	71%	47%	48%	52%	98%	63%	65%	59%
Average Hedge Ratio	100%			50%	49%	49%				
Information Ratio	0.07	12.00	0.82	0.21	0.22	0.19	1.30	0.33	0.36	0.23
Sortino Ratio				0.20	0.21	0.18				
Calmar Ratio				0.05	0.05	0.04				
Average Rolling 1yr Return (Relative to free option)				-2.78%	-2.77%	-2.76%				
Negative Semi-deviation (Relative to free option)				3.42%	3.40%	3.86%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.79%	-2.77%	-2.77%				
Negative Semi-deviation (Relative to investable perfect hedge)				3.16%	3.10%	3.44%				
Turnover				2.36	2.53	11.16				
Trade Size (5th Pctile)				0.19%	0.18%	0.32%				
Trade Size (20th Pctile)				0.43%	0.43%	1.06%				
Trade Size (50th Pctile)				1.21%	1.25%	3.23%				
Trade Size (Average)				1.63%	1.71%	5.01%				
Trade Size (80th Pctile)				2.49%	2.65%	7.95%				
Trade Size (95th Pctile)				4.69%	4.96%	15.49%				
Trade Size (99th Pctile)				7.17%	7.64%	24.65%				

In this case the "delta adjustment" feature is only OBPI related and tries to replace the NME in the legacy CRM model. At the same time as running this feature for OBPI we also removed the link to the ATMF delta at initiation for RBPI and replaced it with a flat 50% delta target at initiation. This is how the live RBPI-Momentum strategy sets its delta and this just demonstrates that it is equivalent to using the ATMF delta of an option.

The reason behind the NME for OBPI is more client-related than anything else, as it was meant to address questions relating to residual hedge ratios of the model. Based on theory, we didn't expect any additional value added from this feature and empirically that appears to be the case.

INSIGHT INVESTMENT

Furthermore, in the FNA framework the purpose of this NME is defeated as there is always going to be offsetting by the other factors and like the rebalancing discipline this only makes sense if it is separated from the momentum signal and applied to the net position at implementation.

3.1.6   Risk estimation

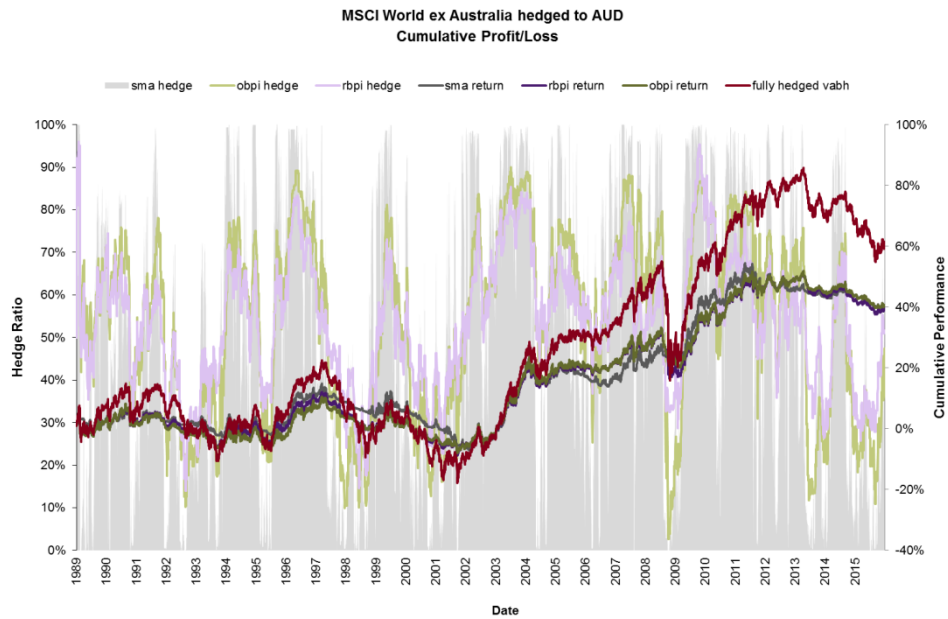### Figure 28 – Cumulative profit/loss from hedging MSCI World ex AUD exposure to AUD

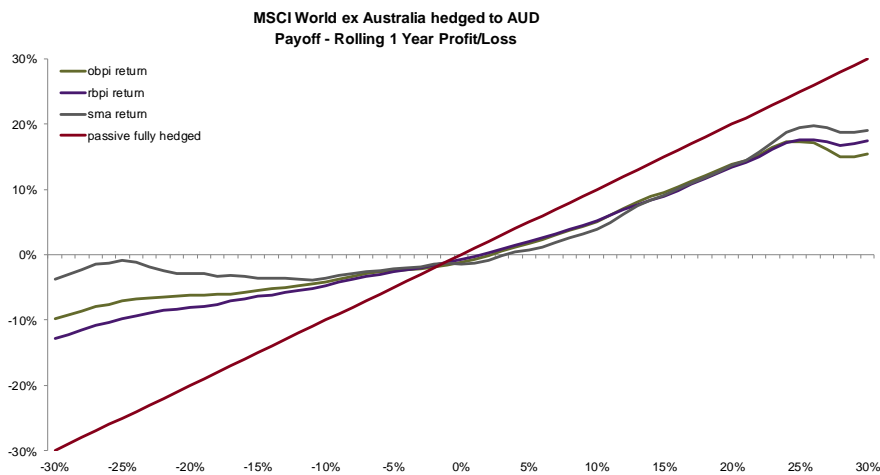### Figure 29 – Profit/loss payoff from hedging MSCI World ex AUD exposure to AUD

INSIGHT INVESTMENT

Table 21 – Annual absolute/relative return for MSCI World ex AUD exposure to AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	7.52%	2.87%	9.57%	2.63%	2.65%	2.88%	4.99%	-1.44%	-1.41%	-0.98%
1990	-1.78%	6.65%	0.06%	-1.07%	-0.78%	-0.00%	1.15%	-0.10%	0.18%	0.92%
1991	-0.44%	2.29%	3.80%	-1.30%	-0.84%	-0.37%	4.07%	-1.06%	-0.60%	-0.15%
1992	-5.39%	0.12%	0.45%	-2.16%	-1.98%	-0.72%	3.73%	0.76%	0.92%	2.05%
1993	-1.73%	0.00%	2.00%	-2.03%	-1.53%	-2.28%	3.06%	-1.09%	-0.59%	-1.39%
1994	8.81%	5.52%	5.69%	3.99%	4.27%	3.55%	0.33%	-0.78%	-0.48%	-0.98%
1995	-2.26%	1.26%	3.52%	-2.53%	-1.54%	-1.79%	4.90%	-1.30%	-0.33%	-0.63%
1996	13.22%	13.51%	12.81%	10.02%	9.44%	9.97%	4.77%	2.85%	2.32%	3.18%
1997	-13.40%	3.87%	0.14%	-4.07%	-6.07%	-2.50%	8.29%	3.19%	1.15%	4.38%
1998	-8.77%	0.00%	-1.76%	-4.07%	-3.97%	-5.06%	3.58%	0.68%	0.76%	-0.56%
1999	9.63%	4.65%	7.22%	3.00%	3.36%	3.72%	1.36%	-2.22%	-1.83%	-1.23%
2000	-11.67%	0.64%	0.06%	-5.38%	-6.14%	-5.86%	7.16%	0.94%	0.15%	0.13%
2001	-3.87%	0.08%	0.86%	-2.94%	-2.73%	-7.81%	3.22%	-0.84%	-0.64%	-5.82%
2002	6.80%	6.04%	6.65%	3.89%	3.50%	3.20%	2.52%	0.21%	-0.16%	-0.29%
2003	26.69%	15.88%	26.69%	20.93%	20.38%	22.11%	10.46%	6.47%	6.00%	8.39%
2004	4.85%	12.21%	4.85%	1.15%	1.34%	0.31%	1.90%	-1.48%	-1.27%	-2.19%
2005	1.67%	6.95%	1.97%	0.28%	0.35%	-2.02%	0.96%	-0.62%	-0.55%	-2.88%
2006	5.39%	1.55%	5.50%	1.88%	2.40%	-0.28%	2.22%	-1.04%	-0.51%	-3.05%
2007	9.12%	9.89%	9.37%	4.55%	4.39%	4.12%	3.83%	-0.39%	-0.52%	-0.57%
2008	-16.13%	6.83%	2.56%	-4.45%	-6.19%	2.53%	12.37%	4.29%	2.49%	10.81%
2009	26.18%	8.11%	21.99%	13.92%	15.40%	17.20%	6.07%	-0.26%	1.30%	3.75%
2010	16.82%	18.71%	16.82%	10.53%	10.10%	10.43%	6.59%	1.42%	1.04%	1.78%
2011	4.70%	13.05%	4.66%	-0.06%	1.08%	-4.68%	1.79%	-2.61%	-1.45%	-7.09%
2012	5.13%	6.19%	4.68%	1.89%	1.76%	-1.32%	1.56%	-0.89%	-1.00%	-3.95%
2013	-10.88%	1.87%	-0.18%	-3.62%	-4.71%	-1.84%	6.43%	2.28%	1.15%	3.75%
2014	-2.00%	1.02%	1.71%	-1.19%	-1.65%	0.34%	2.92%	-0.10%	-0.57%	1.37%
2015	-6.76%	0.00%	0.00%	-3.04%	-2.61%	-3.95%	4.11%	0.62%	1.03%	-0.47%

Table 22 – Summary statistics for absolute/relative return for MSCI World ex AUD exposure to AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	2.27%	5.53%	5.60%	1.50%	1.46%	1.47%	4.22%	0.28%	0.24%	0.31%
Median	2.85%	2.85%	3.96%	0.45%	0.81%	0.30%				
Skew	0.07	1.52	1.18	0.97	0.81	1.28				
Volatility	11.11%	0.43%	7.13%	5.66%	5.70%	5.69%	4.19%	3.20%	1.98%	4.27%
Negative Semi-deviation			8.04%	6.26%	6.27%	6.11%				
Average drawdown			-2.07%	-6.75%	-6.43%	-6.89%				
Maximum drawdown			-12.07%	-18.59%	-21.02%	-21.95%				
% Positive Years	54%	92%	83%	53%	55%	53%	97%	50%	49%	52%
Average Hedge Ratio	100%			54%	54%	51%				
Information Ratio	0.20	12.84	0.79	0.27	0.26	0.26	1.01	0.09	0.12	0.07
Sortino Ratio				0.24	0.23	0.24				
Calmar Ratio				0.08	0.07	0.07				
Average Rolling 1yr Return (Relative to free option)				-3.99%	-4.05%	-4.00%				
Negative Semi-deviation (Relative to free option)				4.71%	4.74%	5.33%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-4.06%	-4.12%	-4.07%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.57%	4.66%	4.80%				
Turnover				2.42	1.68	12.62				
Trade Size (5th Pctile)				0.16%	0.11%	0.25%				
Trade Size (20th Pctile)				0.29%	0.24%	0.95%				
Trade Size (50th Pctile)				0.95%	0.80%	3.42%				
Trade Size (Average)				1.80%	1.58%	5.82%				
Trade Size (80th Pctile)				3.07%	2.91%	9.41%				
Trade Size (95th Pctile)				5.74%	4.81%	19.42%				
Trade Size (99th Pctile)				8.65%	7.21%	34.31%				

INSIGHT INVESTMENT

Figure 30 – Cumulative profit/loss from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Cumulative Profit/Loss
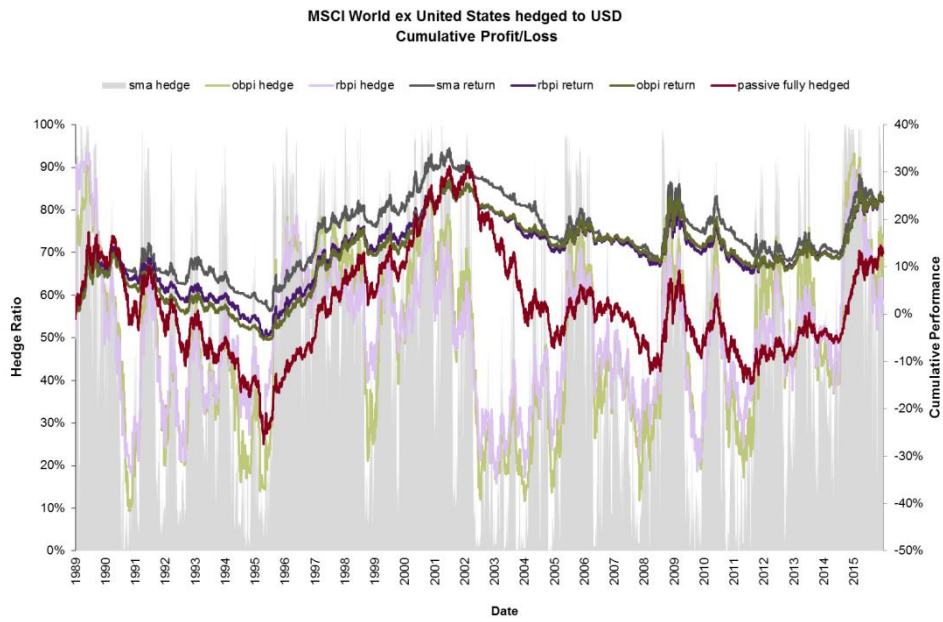
Figure 31 – Profit/loss payoff from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Payoff - Rolling 1 Year Profit/Loss
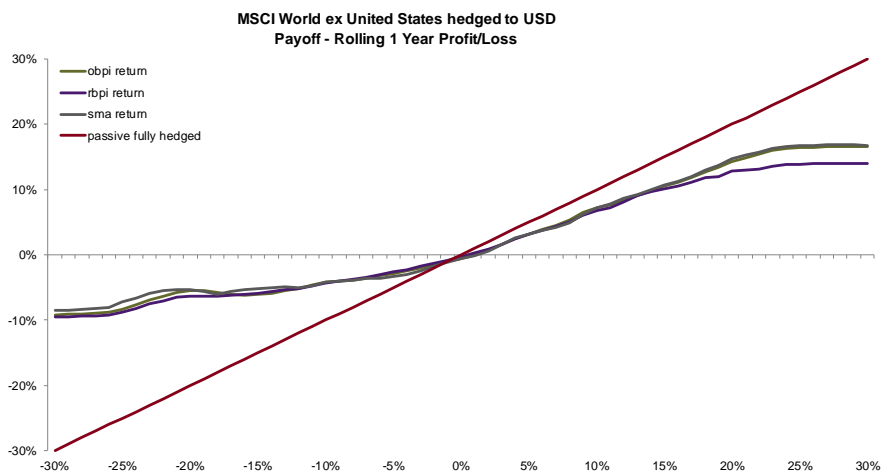
Table 23 – Annual absolute/relative return for MSCI World ex USD exposure to USD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	10.79%	9.76%	12.13%	8.36%	9.78%	8.64%	6.66%	2.98%	4.36%	3.35%
1990	-9.24%	3.24%	1.15%	-2.31%	-1.94%	0.52%	5.84%	2.29%	2.71%	5.05%
1991	-5.68%	0.43%	0.12%	-3.71%	-3.28%	-0.35%	3.00%	-0.87%	-0.43%	2.44%
1992	3.39%	0.13%	1.24%	1.27%	1.16%	2.32%	-0.48%	-0.42%	-0.55%	0.66%
1993	-4.28%	0.30%	-0.65%	-1.71%	-1.45%	-2.50%	1.52%	0.42%	0.70%	-0.40%
1994	-9.14%	0.00%	0.27%	-4.61%	-5.01%	-4.83%	4.91%	-0.05%	-0.41%	-0.34%
1995	0.76%	0.20%	5.06%	1.59%	1.65%	2.12%	4.67%	1.21%	1.27%	1.75%
1996	8.22%	10.04%	8.22%	6.98%	6.43%	7.39%	4.05%	2.89%	2.30%	3.36%
1997	12.93%	11.06%	12.66%	8.98%	8.26%	8.02%	6.11%	2.53%	1.76%	1.67%
1998	-3.83%	5.89%	-1.82%	-2.39%	-2.24%	-2.69%	0.12%	-0.48%	-0.31%	-0.81%
1999	6.97%	2.09%	6.03%	2.91%	3.70%	4.46%	2.50%	-0.56%	0.20%	1.04%
2000	10.75%	9.35%	10.77%	6.78%	5.68%	7.58%	5.32%	1.42%	0.28%	2.31%
2001	7.07%	7.81%	6.42%	4.04%	3.45%	0.14%	2.83%	0.51%	-0.10%	-3.33%
2002	-12.86%	1.47%	0.30%	-4.50%	-4.66%	-3.95%	6.82%	1.91%	1.80%	2.35%
2003	-15.66%	0.00%	0.00%	-4.00%	-5.01%	-3.98%	7.94%	3.80%	2.86%	3.70%
2004	-7.37%	0.00%	-1.87%	-3.43%	-3.45%	-6.86%	1.86%	0.25%	0.25%	-3.25%
2005	12.64%	2.18%	8.57%	4.98%	5.59%	5.32%	2.16%	-1.32%	-0.77%	-0.88%
2006	-4.99%	3.00%	-1.41%	-3.33%	-3.16%	-5.48%	1.12%	-0.84%	-0.65%	-3.03%
2007	-6.35%	0.04%	-0.13%	-2.78%	-2.80%	-1.76%	3.08%	0.38%	0.39%	1.35%
2008	7.21%	2.38%	9.25%	6.81%	5.53%	8.95%	5.59%	3.21%	1.91%	5.41%
2009	-6.51%	7.08%	-0.24%	-5.19%	-4.51%	-5.27%	3.06%	-1.95%	-1.24%	-2.08%
2010	-2.70%	0.92%	1.42%	-2.09%	-2.08%	-0.98%	2.79%	-0.74%	-0.73%	0.35%
2011	0.02%	0.01%	2.81%	-1.35%	-0.57%	-2.45%	2.79%	-1.36%	-0.58%	-2.47%
2012	-0.13%	2.99%	0.09%	-1.08%	-0.56%	-2.23%	0.16%	-1.02%	-0.49%	-2.16%
2013	3.75%	3.93%	4.47%	2.51%	2.36%	2.40%	2.57%	0.64%	0.47%	0.56%
2014	10.28%	2.61%	10.60%	7.46%	7.08%	8.30%	5.39%	2.33%	1.92%	3.26%
2015	7.51%	13.10%	7.51%	4.50%	4.39%	1.93%	3.70%	0.75%	0.61%	-1.76%

Table 24 – Summary statistics for absolute/relative return for MSCI World ex USD exposure to USD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	0.50%	3.69%	3.80%	0.91%	0.90%	0.91%	3.55%	0.66%	0.65%	0.67%
Median	0.19%	0.19%	1.92%	-0.32%	-0.08%	0.22%				
Skew	(0.01)	1.12	0.87	0.56	0.54	0.53				
Volatility	7.69%	0.31%	4.65%	4.42%	4.22%	4.85%	2.72%	2.03%	1.56%	2.91%
Negative Semi-deviation			4.91%	4.60%	4.36%	4.97%				
Average drawdown			-2.42%	-9.84%	-9.73%	-10.82%				
Maximum drawdown			-7.57%	-19.40%	-20.31%	-24.67%				
% Positive Years	50%	88%	71%	47%	49%	52%	98%	63%	63%	59%
Average Hedge Ratio	100%			50%	50%	49%				
Information Ratio	0.07	12.00	0.82	0.21	0.21	0.19	1.30	0.33	0.41	0.23
Sortino Ratio				0.20	0.21	0.18				
Calmar Ratio				0.05	0.04	0.04				
Average Rolling 1yr Return (Relative to free option)				-2.82%	-2.84%	-2.76%				
Negative Semi-deviation (Relative to free option)				3.45%	3.46%	3.86%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.83%	-2.84%	-2.77%				
Negative Semi-deviation (Relative to investable perfect hedge)				3.19%	3.21%	3.44%				
Turnover				2.05	1.57	11.16				
Trade Size (5th Pctile)				0.18%	0.15%	0.32%				
Trade Size (20th Pctile)				0.40%	0.35%	1.06%				
Trade Size (50th Pctile)				1.17%	1.12%	3.23%				
Trade Size (Average)				1.53%	1.39%	5.01%				
Trade Size (80th Pctile)				2.32%	2.12%	7.95%				
Trade Size (95th Pctile)				4.32%	3.86%	15.49%				
Trade Size (99th Pctile)				6.66%	5.69%	24.65%				

Running our momentum models with different risk estimates doesn't actually make much difference and even introducing a more complicated model (like the skew logistic) for the volatility estimation doesn't seem to translate in further gains.

It is, at first, surprising that the risk estimate feature associated with RBPI (3.78 daily standard deviations for RiskMetrics EWMA) results in a notable reduction in turnover when introduced to the base case in isolation. This reduction in turnover slightly reduces the summary statistics from a US and Australian dollar base. This reduction in turnover is due to the fact that the risk estimation feature is being added independently of the time to expiry feature which includes the margin floor.

The effect of this risk estimation feature is that the average RBPI multiplier is double what it is in the base case as the risk estimate in the denominator of the multiplier calculation has a shorter horizon. This doubling of the multiplier increases the gamma of the strategy when its cost is still constrained by the cost implied by the multiplier at initiation and an initial delta of 50%. This effect of this feature is therefore to constrain risk-taking ability associated with the RBPI cushion which the margin floor is meant to alleviate. This effect is exaggerated by the decreasing time to expiry function associated with the base case and the random time-based exponential increase in the multiplier. The margin floor feature effectively makes the RBPI-Momentum like the OBPI-Momentum in that the realised cost of the process is largely unconstrained and the impact of the risk estimation can only truly be assessed together with the RBPI-Momentum time to expiry feature.

3.1.7   Live strategy

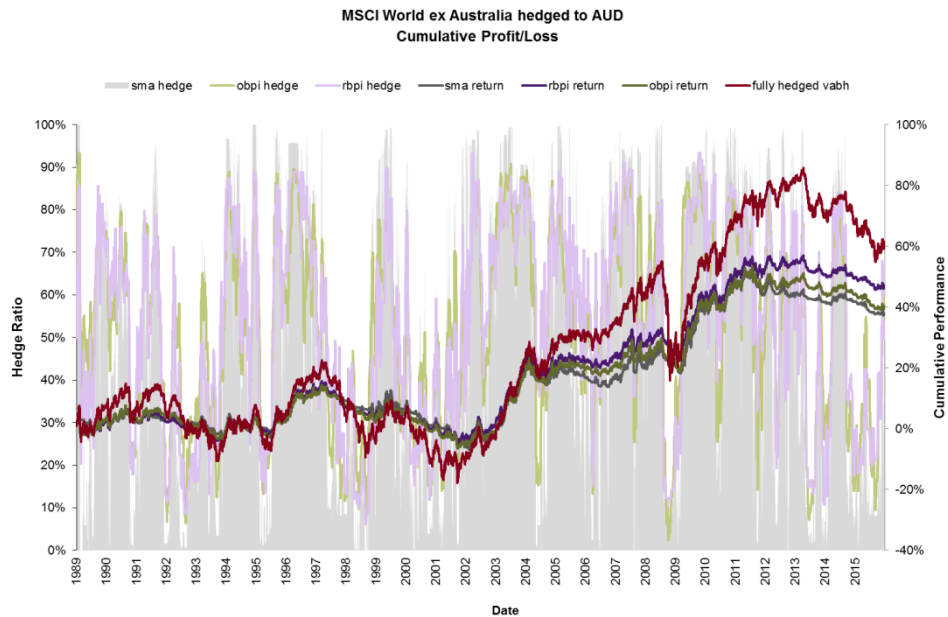Figure 32 – Cumulative profit/loss from hedging MSCI World ex AUD exposure to AUD

INSIGHT INVESTMENT

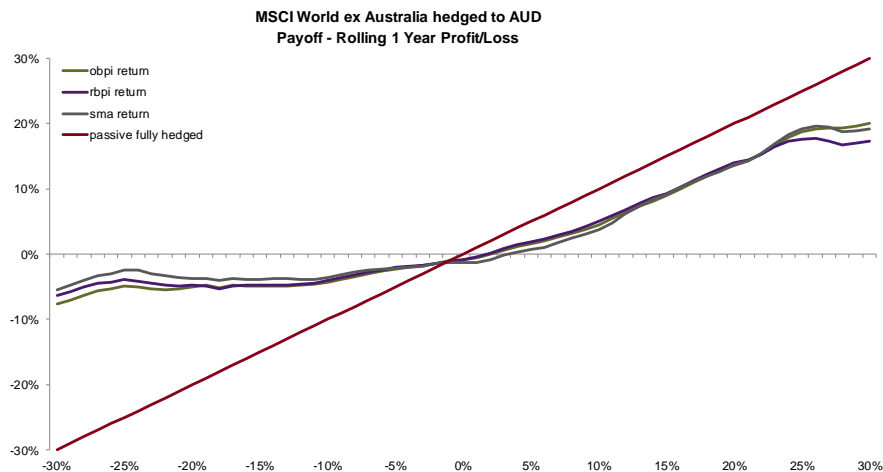## Figure 33 – Profit/loss payoff from hedging MSCI World ex AUD exposure to AUD

MSCI World ex Australia hedged to AUD
Payoff - Rolling 1 Year Profit/Loss

Table 25 – Annual absolute/relative return for MSCI World ex AUD exposure to AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	7.52%	2.87%	9.57%	3.22%	2.65%	2.96%	4.99%	-0.81%	-1.38%	-0.87%
1990	-1.78%	6.65%	0.06%	-0.54%	-0.33%	-0.38%	1.15%	0.41%	0.62%	0.53%
1991	-0.44%	2.29%	3.80%	0.98%	-0.02%	-0.21%	4.07%	1.22%	0.21%	0.02%
1992	-5.39%	0.12%	0.45%	-2.44%	-2.13%	-0.68%	3.73%	0.45%	0.76%	2.07%
1993	-1.73%	0.00%	2.00%	-1.82%	-1.03%	-1.84%	3.06%	-0.89%	-0.10%	-0.95%
1994	8.81%	5.52%	5.69%	4.12%	4.52%	4.11%	0.33%	-0.60%	-0.20%	-0.38%
1995	-2.26%	1.26%	3.52%	-0.50%	-0.69%	-1.54%	4.90%	0.71%	0.52%	-0.38%
1996	13.22%	13.51%	12.81%	8.89%	10.23%	9.69%	4.77%	1.81%	3.15%	2.95%
1997	-13.40%	3.87%	0.14%	-4.12%	-6.01%	-2.95%	8.29%	3.05%	1.17%	3.88%
1998	-8.77%	0.00%	-1.76%	-5.49%	-3.21%	-4.81%	3.58%	-0.79%	1.49%	-0.34%
1999	9.63%	4.65%	7.22%	3.99%	2.11%	3.36%	1.36%	-1.17%	-3.05%	-1.55%
2000	-11.67%	0.64%	0.06%	-6.00%	-5.16%	-5.65%	7.16%	0.25%	1.09%	0.30%
2001	-3.87%	0.08%	0.86%	-5.44%	-4.02%	-8.04%	3.22%	-3.36%	-1.94%	-6.07%
2002	6.80%	6.04%	6.65%	3.54%	3.75%	3.30%	2.52%	-0.10%	0.11%	-0.17%
2003	26.69%	15.88%	26.69%	20.35%	20.21%	21.43%	10.46%	6.05%	5.90%	7.82%
2004	4.85%	12.21%	4.85%	1.58%	1.56%	0.35%	1.90%	-1.02%	-1.04%	-2.12%
2005	1.67%	6.95%	1.97%	-0.57%	-0.48%	-2.13%	0.96%	-1.46%	-1.38%	-2.98%
2006	5.39%	1.55%	5.50%	1.28%	2.17%	-0.01%	2.22%	-1.61%	-0.72%	-2.76%
2007	9.12%	9.89%	9.37%	2.53%	3.84%	3.71%	3.83%	-2.35%	-1.05%	-0.95%
2008	-16.13%	6.83%	2.56%	-1.34%	-1.03%	1.10%	12.37%	7.30%	7.61%	9.32%
2009	26.18%	8.11%	21.99%	18.26%	15.81%	17.23%	6.07%	4.24%	1.79%	3.88%
2010	16.82%	18.71%	16.82%	9.12%	9.97%	10.59%	6.59%	0.12%	0.96%	2.01%
2011	4.70%	13.05%	4.66%	-2.29%	0.05%	-4.78%	1.79%	-4.81%	-2.47%	-7.18%
2012	5.13%	6.19%	4.68%	0.92%	1.44%	-1.27%	1.56%	-1.83%	-1.31%	-3.89%
2013	-10.88%	1.87%	-0.18%	-3.86%	-3.59%	-1.82%	6.43%	1.97%	2.24%	3.72%
2014	-2.00%	1.02%	1.71%	-0.15%	-0.96%	0.02%	2.92%	0.92%	0.11%	1.05%
2015	-6.76%	0.00%	0.00%	-3.89%	-2.50%	-3.84%	4.11%	-0.27%	1.12%	-0.39%

Table 26 – Summary statistics for absolute/relative return for MSCI World ex AUD exposure to AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	2.27%	5.53%	5.60%	1.49%	1.74%	1.40%	4.22%	0.27%	0.52%	0.24%
Median	2.85%	2.85%	3.96%	0.57%	0.71%	0.17%				
Skew	0.07	1.52	1.18	1.16	1.03	1.28				
Volatility	11.11%	0.43%	7.13%	5.64%	5.57%	5.66%	4.19%	3.30%	3.16%	4.05%
Negative Semi-deviation			8.04%	6.20%	6.11%	6.11%				
Average drawdown			-2.07%	-6.41%	-6.03%	-6.92%				
Maximum drawdown			-12.07%	-21.10%	-20.71%	-22.70%				
% Positive Years	54%	92%	83%	55%	56%	52%	97%	51%	54%	53%
Average Hedge Ratio	100%			54%	54%	51%				
Information Ratio	0.20	12.84	0.79	0.26	0.31	0.25	1.01	0.08	0.17	0.06
Sortino Ratio				0.24	0.28	0.23				
Calmar Ratio				0.07	0.08	0.06				
Average Rolling 1yr Return (Relative to free option)				-3.99%	-3.76%	-4.08%				
Negative Semi-deviation (Relative to free option)				4.88%	4.63%	5.36%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-4.07%	-3.83%	-4.15%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.48%	4.21%	4.85%				
Turnover				2.45	2.87	9.62				
Trade Size (5th Pctile)				0.08%	0.08%	0.45%				
Trade Size (20th Pctile)				0.23%	0.60%	1.26%				
Trade Size (50th Pctile)				0.72%	2.08%	3.67%				
Trade Size (Average)				1.40%	3.69%	7.00%				
Trade Size (80th Pctile)				2.07%	6.71%	11.74%				
Trade Size (95th Pctile)				5.00%	11.76%	23.43%				
Trade Size (99th Pctile)				8.50%	17.29%	36.78%				

Figure 34– Cumulative profit/loss from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Cumulative Profit/Loss
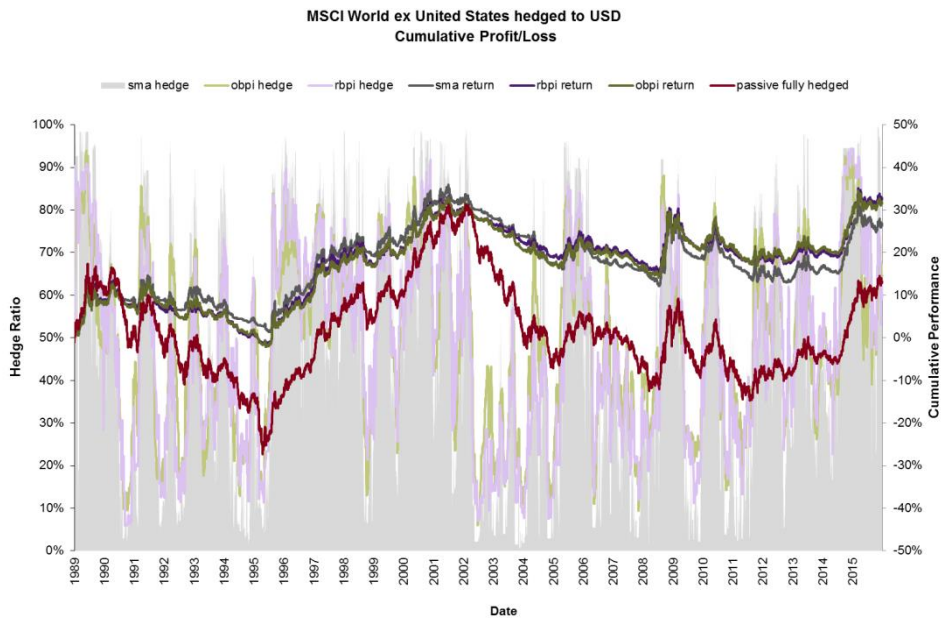
Figure 35 – Profit/loss payoff from hedging MSCI World ex USD exposure to USD

MSCI World ex United States hedged to USD
Payoff - Rolling 1 Year Profit/Loss
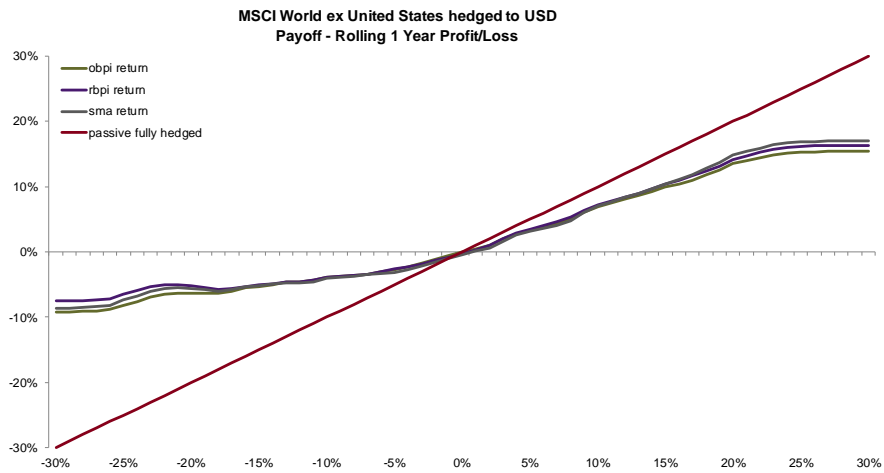
Table 27 – Annual absolute/relative return for MSCI World ex USD exposure to USD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	10.79%	9.76%	12.13%	8.03%	8.36%	8.12%	6.66%	2.63%	3.11%	2.85%
1990	-9.24%	3.24%	1.15%	-0.41%	-0.47%	0.81%	5.84%	4.22%	4.03%	5.33%
1991	-5.68%	0.43%	0.12%	-0.39%	-1.42%	-0.12%	3.00%	2.45%	1.34%	2.66%
1992	3.39%	0.13%	1.24%	1.23%	0.68%	2.36%	-0.48%	-0.47%	-0.97%	0.70%
1993	-4.28%	0.30%	-0.65%	-2.08%	-0.69%	-2.50%	1.52%	0.06%	1.39%	-0.41%
1994	-9.14%	0.00%	0.27%	-5.13%	-5.77%	-4.67%	4.91%	-0.56%	-1.32%	-0.20%
1995	0.76%	0.20%	5.06%	3.06%	3.95%	2.67%	4.67%	2.68%	3.58%	2.29%
1996	8.22%	10.04%	8.22%	6.39%	7.26%	7.30%	4.05%	2.28%	3.26%	3.29%
1997	12.93%	11.06%	12.66%	8.00%	8.02%	8.05%	6.11%	1.53%	1.73%	1.73%
1998	-3.83%	5.89%	-1.82%	-1.95%	-2.89%	-2.79%	0.12%	-0.03%	-1.03%	-0.92%
1999	6.97%	2.09%	6.03%	3.97%	4.16%	4.60%	2.50%	0.48%	0.76%	1.19%
2000	10.75%	9.35%	10.77%	7.02%	6.91%	7.51%	5.32%	1.64%	1.68%	2.26%
2001	7.07%	7.81%	6.42%	2.35%	2.12%	0.85%	2.83%	-1.19%	-1.32%	-2.60%
2002	-12.86%	1.47%	0.30%	-4.30%	-3.60%	-4.14%	6.82%	2.13%	2.66%	2.14%
2003	-15.66%	0.00%	0.00%	-5.18%	-4.28%	-4.19%	7.94%	2.66%	3.34%	3.46%
2004	-7.37%	0.00%	-1.87%	-3.71%	-3.44%	-6.41%	1.86%	-0.02%	0.15%	-2.81%
2005	12.64%	2.18%	8.57%	6.00%	5.26%	5.55%	2.16%	-0.33%	-0.89%	-0.63%
2006	-4.99%	3.00%	-1.41%	-3.27%	-3.52%	-5.32%	1.12%	-0.77%	-1.09%	-2.88%
2007	-6.35%	0.04%	-0.13%	-3.00%	-3.13%	-1.89%	3.08%	0.18%	-0.04%	1.21%
2008	7.21%	2.38%	9.25%	8.54%	8.22%	8.51%	5.59%	4.93%	4.71%	4.99%
2009	-6.51%	7.08%	-0.24%	-3.67%	-4.19%	-5.22%	3.06%	-0.41%	-1.02%	-2.04%
2010	-2.70%	0.92%	1.42%	-0.55%	-1.33%	-1.47%	2.79%	0.81%	-0.02%	-0.14%
2011	0.02%	0.01%	2.81%	-1.05%	-1.07%	-1.77%	2.79%	-1.07%	-1.08%	-1.78%
2012	-0.13%	2.99%	0.09%	-0.95%	-1.02%	-1.87%	0.16%	-0.89%	-0.96%	-1.81%
2013	3.75%	3.93%	4.47%	2.02%	2.14%	2.73%	2.57%	0.15%	0.31%	0.89%
2014	10.28%	2.61%	10.60%	7.95%	8.29%	8.22%	5.39%	2.81%	3.29%	3.20%
2015	7.51%	13.10%	7.51%	3.02%	4.36%	2.02%	3.70%	-0.74%	0.71%	-1.65%

Table 28 – Summary statistics for absolute/relative return for MSCI World ex USD exposure to USD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	0.50%	3.69%	3.80%	1.18%	1.21%	0.99%	3.55%	0.93%	0.97%	0.75%
Median	0.19%	0.19%	1.92%	0.58%	-0.01%	0.44%				
Skew	(0.01)	1.12	0.87	0.47	0.62	0.47				
Volatility	7.69%	0.31%	4.65%	4.46%	4.40%	4.80%	2.72%	2.11%	2.21%	2.86%
Negative Semi-deviation			4.91%	4.61%	4.55%	4.94%				
Average drawdown			-2.42%	-8.21%	-8.30%	-10.42%				
Maximum drawdown			-7.57%	-18.98%	-18.09%	-23.80%				
% Positive Years	50%	88%	71%	54%	50%	54%	98%	69%	62%	62%
Average Hedge Ratio	100%			50%	49%	49%				
Information Ratio	0.07	12.00	0.82	0.26	0.28	0.21	1.30	0.44	0.44	0.26
Sortino Ratio				0.26	0.27	0.20				
Calmar Ratio				0.06	0.07	0.04				
Average Rolling 1yr Return (Relative to free option)				-2.53%	-2.51%	-2.69%				
Negative Semi-deviation (Relative to free option)				3.46%	3.27%	3.76%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.54%	-2.52%	-2.69%				
Negative Semi-deviation (Relative to investable perfect hedge)				2.98%	2.87%	3.36%				
Turnover				2.12	2.68	8.52				
Trade Size (5th Pctile)				0.09%	0.12%	0.50%				
Trade Size (20th Pctile)				0.23%	0.85%	1.49%				
Trade Size (50th Pctile)				0.69%	2.76%	4.40%				
Trade Size (Average)				1.14%	3.42%	6.07%				
Trade Size (80th Pctile)				1.74%	5.42%	9.53%				
Trade Size (95th Pctile)				3.71%	9.62%	17.33%				
Trade Size (99th Pctile)				6.31%	13.84%	27.55%				

The live strategy simulation shown above is a representation of what we are running in our live portfolios (OBPI-Momentum in North America and UK and RBPI-Momentum in Australia). There is very little difference between them, both in a statistical sense and from a practical point of view. At the margin, if our choice is to be a strictly objective one based on the relevant summary statistics like risk-adjusted return, deviation from the free option and turnover one would choose RBPI-Momentum over OBPI-Momentum. However any decision about which strategy to implement will likely be mostly a subjective one given how small the differences are between them. Ultimately our choice may be simply a matter of preference.

In these results we see the full effect of the rebalancing discipline, time to expiry and risk estimation features of each strategy. It is the combination of the time to expiry function and the risk estimation that add the most value for the RBPI-Momentum and the 15% minimum trade constraint acts to effectively reduce turnover such that it is lower than OBPI-Momentum.

INSIGHT INVESTMENT

It is also interesting to note that the difference between the base case and the live implementations is also marginal particularly for OBPI-Momentum despite all the additional features. However, given that we have shown that the OBPI and RBPI base cases are equivalent at the start we should be able to replace the OBPI-Momentum features with those of RBPI-Momentum and achieve the same improvement with OBPI-Momentum relative to the base case.

3.2   Equally weighted basket – 21 currency pairs

3.2.1   Base case

Figure 36 – Cumulative profit/loss from equal weight cross-hedging 21 pairs via AUD
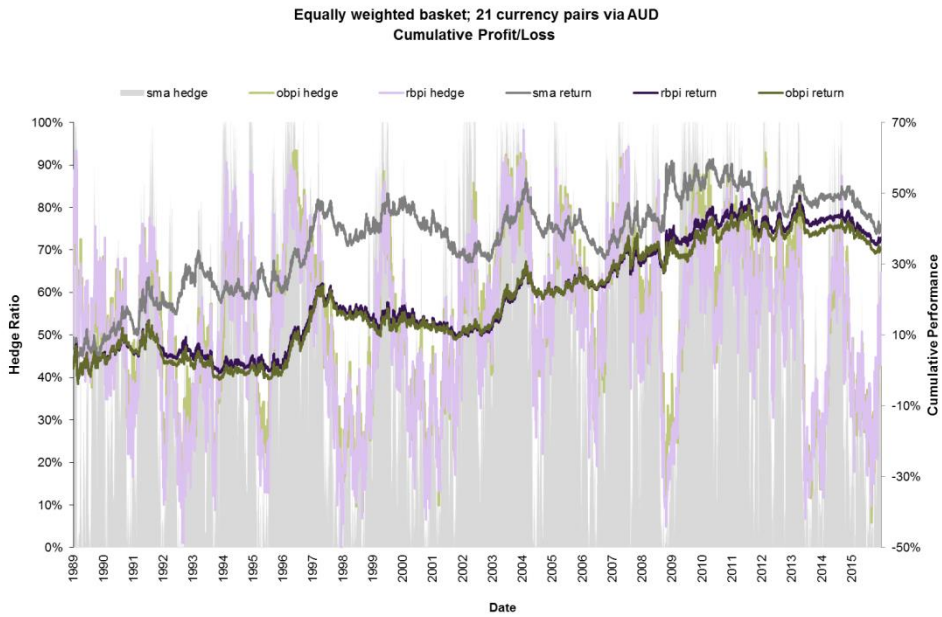

Figure 37 – Difference in aggregate hedge ratio equal weight cross-hedging 21 pairs via AUD
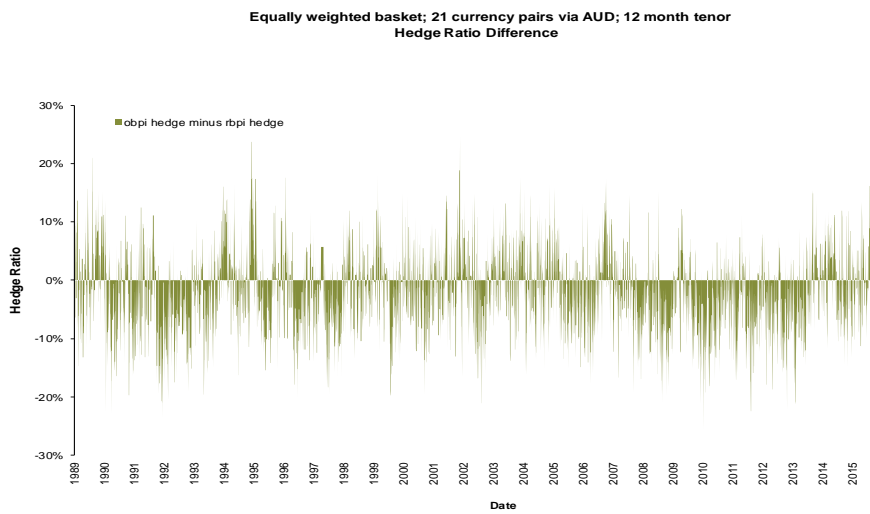
Figure 38 – Rolling annual Sortino ratio equal weight cross-hedging 21 pairs via AUD
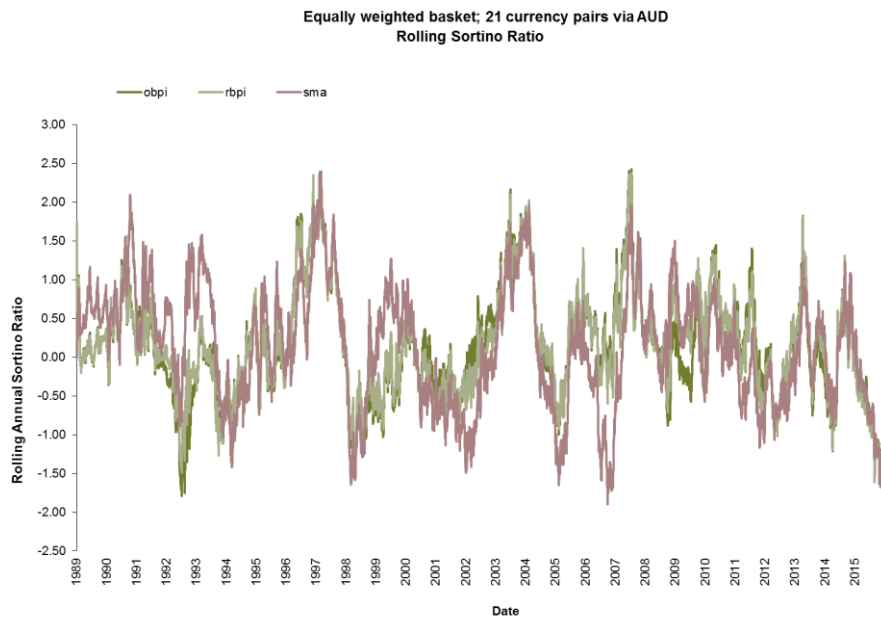

Equally weighted basket; 21 currency pairs via AUD
Rolling Sortino Ratio

Table 29 – Annual absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	2.75%	1.77%	5.66%	4.26%	4.51%	8.58%	4.02%	2.77%	3.08%	7.17%
1990	-6.64%	1.26%	-3.26%	0.82%	0.56%	3.95%	0.70%	4.43%	4.01%	7.35%
1991	0.22%	2.44%	4.87%	-1.41%	1.19%	9.10%	4.74%	-1.53%	1.08%	8.99%
1992	-3.13%	0.32%	0.89%	-1.72%	-1.70%	5.21%	2.75%	-0.02%	-0.07%	6.81%
1993	-0.68%	0.05%	1.36%	-3.69%	-4.25%	-5.89%	1.76%	-3.32%	-3.90%	-5.54%
1994	6.71%	4.10%	4.18%	2.99%	3.17%	2.97%	0.18%	-0.66%	-0.33%	-0.46%
1995	-4.33%	0.64%	1.75%	-1.28%	-1.81%	-1.87%	4.34%	1.07%	0.44%	0.35%
1996	12.19%	10.96%	11.82%	16.99%	16.29%	18.34%	4.54%	10.36%	9.94%	12.10%
1997	-9.62%	4.38%	0.82%	-0.96%	-0.53%	-0.40%	6.56%	4.27%	4.48%	4.52%
1998	-7.25%	0.00%	-1.98%	-3.20%	-2.95%	-0.09%	2.34%	0.74%	0.83%	3.62%
1999	8.56%	3.68%	6.56%	3.58%	3.70%	8.83%	1.46%	-1.07%	-0.76%	4.45%
2000	-7.74%	0.68%	-0.11%	-4.19%	-4.99%	-5.69%	4.51%	0.02%	-0.97%	-1.73%
2001	-1.54%	0.05%	0.86%	-1.11%	-2.35%	-9.77%	1.77%	-0.27%	-1.55%	-8.99%
2002	1.89%	3.36%	1.80%	2.61%	1.97%	0.91%	0.68%	1.58%	0.99%	-0.06%
2003	15.78%	8.18%	15.78%	12.34%	12.71%	14.15%	6.35%	3.77%	4.49%	6.07%
2004	0.89%	6.47%	1.07%	-3.18%	-2.52%	-6.78%	0.53%	-3.67%	-2.98%	-7.23%
2005	3.92%	4.74%	3.92%	3.03%	3.24%	0.53%	1.59%	0.91%	1.20%	-1.48%
2006	3.36%	1.16%	3.81%	2.95%	2.05%	-4.91%	1.80%	1.12%	0.30%	-6.63%
2007	4.61%	7.14%	4.88%	3.36%	2.45%	1.58%	2.12%	0.85%	0.05%	-0.78%
2008	-13.58%	3.34%	1.90%	4.46%	8.93%	20.22%	10.01%	11.84%	16.00%	27.17%
2009	18.10%	5.20%	14.57%	0.68%	0.89%	-6.74%	3.76%	-9.15%	-8.54%	-16.00%
2010	11.60%	13.13%	11.56%	6.61%	6.36%	6.05%	4.63%	0.31%	0.32%	0.12%
2011	2.47%	7.25%	2.44%	-4.43%	-6.03%	-10.22%	0.97%	-5.78%	-7.32%	-11.49%
2012	3.49%	5.15%	3.33%	0.50%	1.08%	-1.01%	1.25%	-1.39%	-0.74%	-2.80%
2013	-10.34%	1.94%	0.21%	-0.02%	1.13%	2.83%	6.38%	5.60%	6.52%	8.13%
2014	1.04%	0.70%	1.65%	0.48%	-0.10%	0.64%	1.03%	-0.09%	-0.64%	0.11%
2015	-4.08%	0.06%	-0.01%	-5.61%	-5.48%	-9.27%	2.42%	-3.40%	-3.36%	-7.18%

INSIGHT INVESTMENT

Table 30 – Summary statistics for absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	1.06%	3.62%	3.70%	1.29%	1.38%	1.52%	3.07%	0.71%	0.83%	0.98%
Median	1.63%	1.63%	2.87%	0.78%	0.95%	1.36%				
Skew	(0.06)	1.57	0.98	0.79	0.74	0.26				
Volatility	9.06%	0.29%	5.58%	6.65%	6.68%	8.72%	3.37%	5.87%	6.22%	8.88%
Negative Semi-deviation			6.24%	7.39%	7.33%	9.09%				
Average drawdown			-2.02%	-7.59%	-7.08%	-9.15%				
Maximum drawdown			-9.83%	-16.51%	-15.22%	-22.63%				
% Positive Years	62%	96%	80%	57%	58%	57%	96%	58%	56%	53%
Average Hedge Ratio	100%			54%	52%	51%				
Information Ratio	0.12	12.34	0.66	0.19	0.21	0.17	0.91	0.12	0.13	0.11
Sortino Ratio				0.17	0.19	0.17				
Calmar Ratio				0.08	0.09	0.07				
Average Rolling 1yr Return (Relative to free option)				-2.28%	-2.20%	-2.00%				
Negative Semi-deviation (Relative to free option)				5.11%	5.13%	7.75%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.36%	-2.28%	-2.08%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.76%	4.62%	7.27%				
Turnover				5.26	6.50	17.05				
Trade Size (5th Pctile)				0.51%	0.52%	0.58%				
Trade Size (20th Pctile)				5.08%	5.02%	2.52%				
Trade Size (50th Pctile)				5.67%	5.78%	6.23%				
Trade Size (Average)				5.82%	5.88%	7.62%				
Trade Size (80th Pctile)				6.89%	7.27%	11.50%				
Trade Size (95th Pctile)				11.28%	11.60%	19.57%				
Trade Size (99th Pctile)				14.01%	14.82%	29.28%				

Even in the equally weighted example we observe that OBPI and RBPI are very similar in terms of risk-adjusted returns. However, we notice that the cross hedging application translates into higher turnover than the MSCI cases because it holds a higher gross exposure.

The choice of AUD as the accounting currency rather than netting via another was arbitrary and determined by the ease with which we could compile the numbers but is inconsequential with respect to the comparison between strategies.

INSIGHT INVESTMENT

3.2.2   Tenor

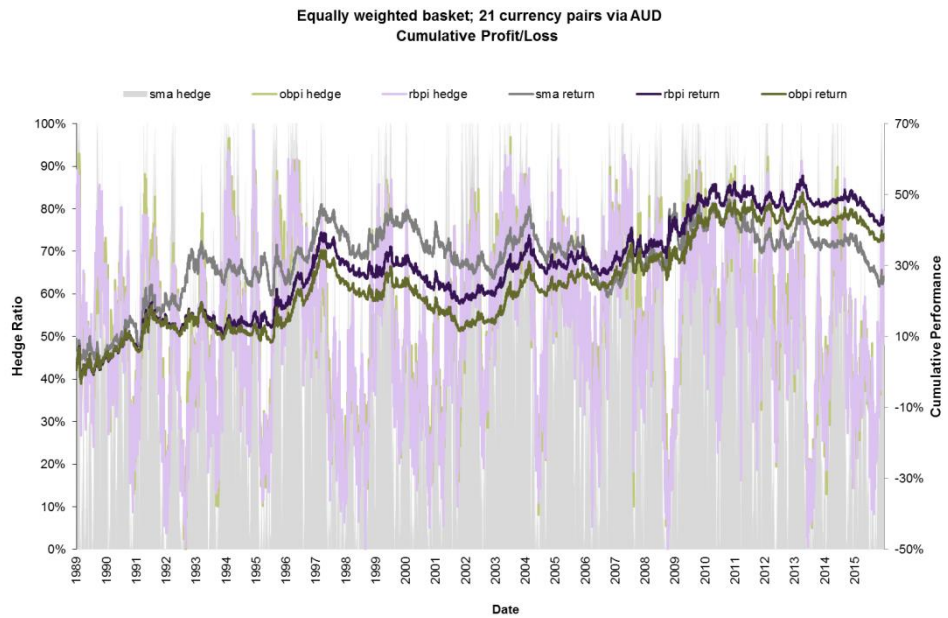Figure 39 – Cumulative profit/loss from equal weight cross-hedging 21 pairs via AUD

Figure 40 – Difference in aggregate hedge ratio equal weight cross-hedging 21 pairs via AUD
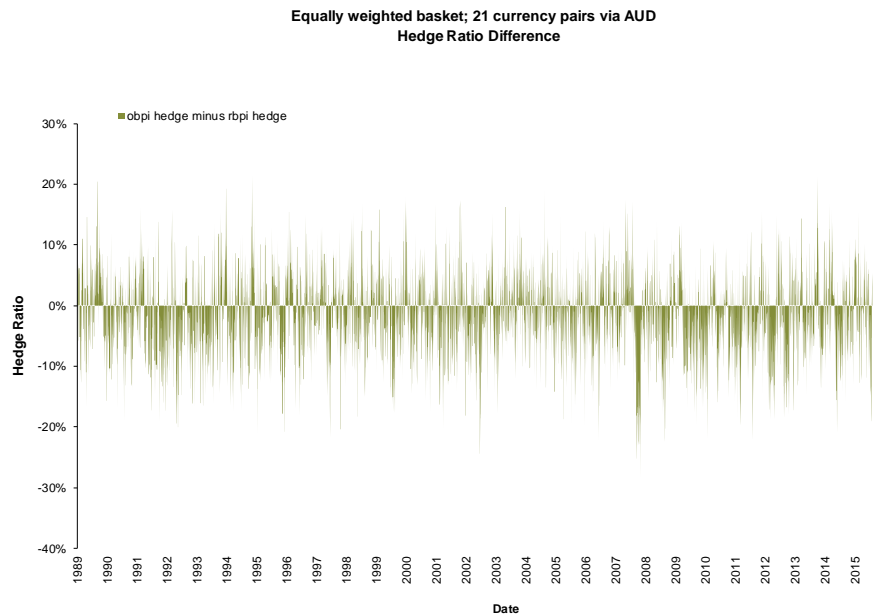
Figure 41 – Rolling annual Sortino ratio equal weight cross-hedging 21 pairs via AUD
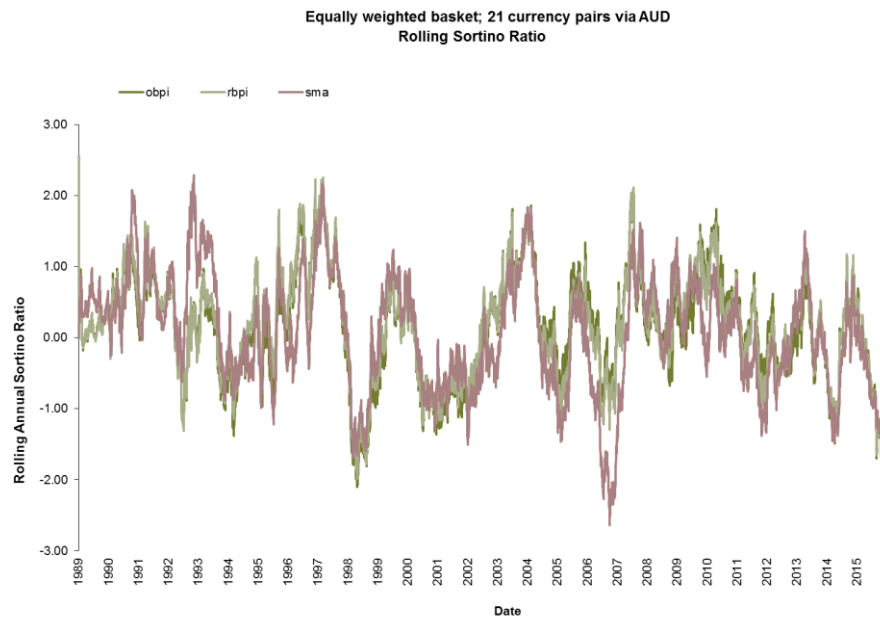

Table 31 – Annual absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	2.75%	1.77%	5.66%	5.21%	4.66%	5.88%	4.02%	3.73%	3.23%	4.45%
1990	-6.64%	1.26%	-3.26%	1.03%	2.26%	5.27%	0.70%	4.60%	5.72%	8.73%
1991	0.22%	2.44%	4.87%	8.92%	8.95%	10.65%	4.74%	8.80%	8.84%	10.54%
1992	-3.13%	0.32%	0.89%	-0.02%	-0.85%	9.15%	2.75%	1.66%	0.78%	10.78%
1993	-0.68%	0.05%	1.36%	-4.03%	-2.53%	-3.33%	1.76%	-3.67%	-2.18%	-2.98%
1994	6.71%	4.10%	4.18%	1.61%	3.48%	0.92%	0.18%	-1.99%	-0.01%	-2.57%
1995	-4.33%	0.64%	1.75%	0.99%	2.33%	-3.85%	4.34%	3.32%	4.58%	-1.60%
1996	12.19%	10.96%	11.82%	14.36%	14.36%	14.91%	4.54%	7.80%	8.01%	8.57%
1997	-9.62%	4.38%	0.82%	-3.17%	-2.17%	-1.19%	6.56%	2.01%	2.84%	3.81%
1998	-7.25%	0.00%	-1.98%	-4.28%	-3.27%	-3.02%	2.34%	-0.38%	0.50%	0.75%
1999	8.56%	3.68%	6.56%	6.05%	5.53%	9.89%	1.46%	1.45%	1.08%	5.44%
2000	-7.74%	0.68%	-0.11%	-7.64%	-6.45%	-5.78%	4.51%	-3.48%	-2.42%	-1.75%
2001	-1.54%	0.05%	0.86%	-5.98%	-5.41%	-8.85%	1.77%	-5.15%	-4.61%	-8.05%
2002	1.89%	3.36%	1.80%	1.32%	1.57%	-1.93%	0.68%	0.30%	0.59%	-2.91%
2003	15.78%	8.18%	15.78%	11.84%	11.53%	13.44%	6.35%	3.35%	3.32%	5.22%
2004	0.89%	6.47%	1.07%	-1.25%	-2.92%	-6.27%	0.53%	-1.73%	-3.39%	-6.73%
2005	3.92%	4.74%	3.92%	2.68%	1.38%	-1.02%	1.59%	0.58%	-0.66%	-3.05%
2006	3.36%	1.16%	3.81%	0.18%	-0.47%	-8.88%	1.80%	-1.62%	-2.22%	-10.62%
2007	4.61%	7.14%	4.88%	0.43%	1.41%	2.40%	2.12%	-2.05%	-1.00%	0.00%
2008	-13.58%	3.34%	1.90%	7.14%	10.28%	18.79%	10.01%	14.45%	17.35%	25.86%
2009	18.10%	5.20%	14.57%	6.23%	3.71%	-6.50%	3.76%	-3.51%	-5.71%	-15.92%
2010	11.60%	13.13%	11.56%	6.63%	6.16%	7.02%	4.63%	0.39%	0.12%	0.98%
2011	2.47%	7.25%	2.44%	-3.91%	-6.11%	-11.85%	0.97%	-5.24%	-7.39%	-13.13%
2012	3.49%	5.15%	3.33%	-0.13%	1.50%	2.81%	1.25%	-2.01%	-0.32%	0.99%
2013	-10.34%	1.94%	0.21%	-1.37%	-1.07%	-1.30%	6.38%	4.20%	4.31%	4.08%
2014	1.04%	0.70%	1.65%	1.59%	1.75%	-0.22%	1.03%	1.03%	1.21%	-0.76%
2015	-4.08%	0.06%	-0.01%	-5.62%	-6.00%	-10.18%	2.42%	-3.42%	-3.88%	-8.06%

Table 32 – Summary statistics for absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	1.06%	3.62%	3.70%	1.43%	1.61%	1.00%	3.07%	0.86%	1.06%	0.44%
Median	1.63%	1.63%	2.87%	1.32%	1.49%	0.91%				
Skew	(0.06)	1.57	0.98	0.35	0.30	0.13				
Volatility	9.06%	0.29%	5.58%	6.64%	6.61%	8.73%	3.37%	5.95%	6.16%	8.79%
Negative Semi-deviation			6.24%	7.22%	7.13%	9.07%				
Average drawdown			-2.02%	-7.56%	-6.94%	-9.71%				
Maximum drawdown			-9.83%	-22.77%	-20.11%	-26.24%				
% Positive Years	62%	96%	80%	61%	62%	54%	96%	56%	56%	49%
Average Hedge Ratio	100%			54%	52%	52%				
Information Ratio	0.12	12.34	0.66	0.22	0.24	0.11	0.91	0.15	0.17	0.05
Sortino Ratio				0.20	0.23	0.11				
Calmar Ratio				0.06	0.08	0.04				
Average Rolling 1yr Return (Relative to free option)				-2.14%	-1.96%	-2.50%				
Negative Semi-deviation (Relative to free option)				4.97%	5.21%	7.94%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.22%	-2.04%	-2.58%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.48%	4.72%	7.47%				
Turnover				8.05	9.72	21.92				
Trade Size (5th Pctile)				0.47%	0.50%	0.65%				
Trade Size (20th Pctile)				3.75%	3.19%	2.65%				
Trade Size (50th Pctile)				5.76%	5.91%	6.98%				
Trade Size (Average)				6.00%	6.19%	9.07%				
Trade Size (80th Pctile)				7.71%	8.27%	14.15%				
Trade Size (95th Pctile)				12.41%	12.83%	24.10%				
Trade Size (99th Pctile)				15.67%	17.09%	36.69%				

Introducing the 6 month tenor feature to the base strategies on an equally weighted basket appears to marginally improve the risk-adjusted return but significantly increases turnover as the average gamma of the book of "options" underlying each strategy is increased. Practically speaking, there is no obvious advantage of the 6 month tenor feature in OBPI over the base case.

INSIGHT INVESTMENT

3.2.3   Rebalancing discipline

Figure 42 – Cumulative profit/loss from equal weight cross-hedging 21 pairs via AUD
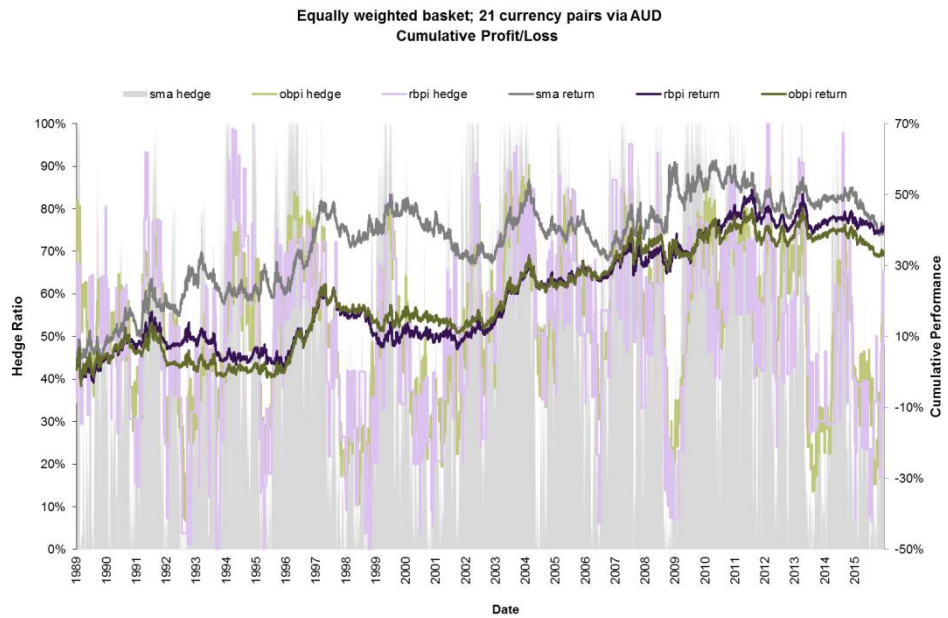
Figure 43 – Difference in aggregate hedge ratio equal weight cross-hedging 21 pairs via AUD
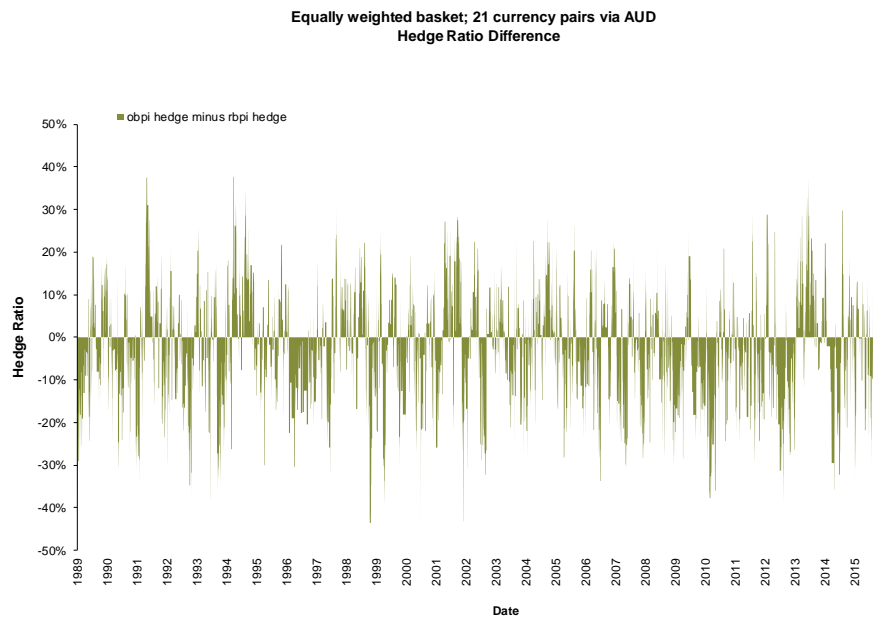
Figure 44 – Rolling annual Sortino ratio equal weight cross-hedging 21 pairs via AUD
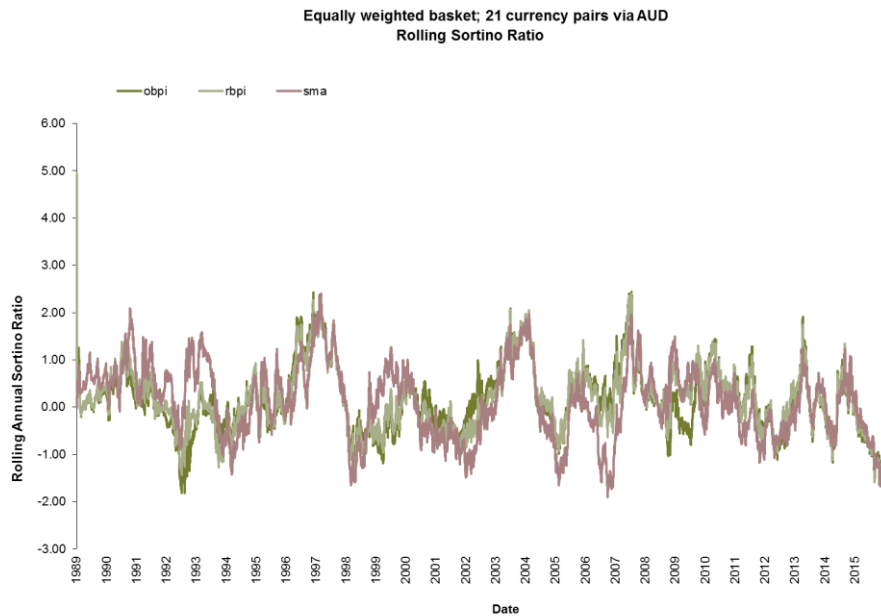

Equally weighted basket; 21 currency pairs via AUD
Rolling Sortino Ratio

Table 33 – Annual absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	2.75%	1.77%	5.66%	4.96%	4.12%	8.58%	4.02%	3.49%	2.73%	7.17%
1990	-6.64%	1.26%	-3.26%	0.54%	3.27%	3.95%	0.70%	4.08%	6.63%	7.35%
1991	0.22%	2.44%	4.87%	-2.21%	0.98%	9.10%	4.74%	-2.33%	0.87%	8.99%
1992	-3.13%	0.32%	0.89%	-1.78%	0.71%	5.21%	2.75%	-0.11%	2.30%	6.81%
1993	-0.68%	0.05%	1.36%	-2.16%	-5.52%	-5.89%	1.76%	-1.80%	-5.17%	-5.54%
1994	6.71%	4.10%	4.18%	2.99%	3.16%	2.97%	0.18%	-0.59%	-0.25%	-0.46%
1995	-4.33%	0.64%	1.75%	-1.11%	-4.04%	-1.87%	4.34%	1.21%	-1.85%	0.35%
1996	12.19%	10.96%	11.82%	16.65%	14.72%	18.34%	4.54%	10.14%	8.54%	12.10%
1997	-9.62%	4.38%	0.82%	-0.14%	-1.00%	-0.40%	6.56%	5.00%	3.88%	4.52%
1998	-7.25%	0.00%	-1.98%	-3.49%	-5.73%	-0.09%	2.34%	0.39%	-2.05%	3.62%
1999	8.56%	3.68%	6.56%	4.04%	2.68%	8.83%	1.46%	-0.54%	-1.66%	4.45%
2000	-7.74%	0.68%	-0.11%	-3.61%	-4.17%	-5.69%	4.51%	0.52%	-0.24%	-1.73%
2001	-1.54%	0.05%	0.86%	-1.33%	1.00%	-9.77%	1.77%	-0.51%	1.78%	-8.99%
2002	1.89%	3.36%	1.80%	2.82%	4.52%	0.91%	0.68%	1.81%	3.56%	-0.06%
2003	15.78%	8.18%	15.78%	12.14%	12.66%	14.15%	6.35%	3.71%	4.65%	6.07%
2004	0.89%	6.47%	1.07%	-3.03%	-1.26%	-6.78%	0.53%	-3.50%	-1.71%	-7.23%
2005	3.92%	4.74%	3.92%	3.24%	3.40%	0.53%	1.59%	1.15%	1.42%	-1.48%
2006	3.36%	1.16%	3.81%	3.51%	1.68%	-4.91%	1.80%	1.71%	-0.03%	-6.63%
2007	4.61%	7.14%	4.88%	2.65%	-0.21%	1.58%	2.12%	0.18%	-2.55%	-0.78%
2008	-13.58%	3.34%	1.90%	2.57%	4.83%	20.22%	10.01%	9.82%	11.72%	27.17%
2009	18.10%	5.20%	14.57%	0.86%	3.10%	-6.74%	3.76%	-8.82%	-6.08%	-16.00%
2010	11.60%	13.13%	11.56%	5.76%	8.26%	6.05%	4.63%	-0.44%	2.38%	0.12%
2011	2.47%	7.25%	2.44%	-4.93%	-2.62%	-10.22%	0.97%	-6.25%	-3.87%	-11.49%
2012	3.49%	5.15%	3.33%	-0.33%	-2.32%	-1.01%	1.25%	-2.20%	-4.09%	-2.80%
2013	-10.34%	1.94%	0.21%	0.67%	0.78%	2.83%	6.38%	6.20%	6.02%	8.13%
2014	1.04%	0.70%	1.65%	0.21%	0.56%	0.64%	1.03%	-0.35%	0.03%	0.11%
2015	-4.08%	0.06%	-0.01%	-5.31%	-2.46%	-9.27%	2.42%	-3.13%	-0.39%	-7.18%

Table 34 – Summary statistics for absolute/relative return for equal weight cross-hedging 21pairs via AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	1.06%	3.62%	3.70%	1.26%	1.52%	1.52%	3.07%	0.70%	0.98%	0.98%
Median	1.63%	1.63%	2.87%	0.77%	1.02%	1.36%				
Skew	(0.06)	1.57	0.98	0.75	0.46	0.26				
Volatility	9.06%	0.29%	5.58%	6.57%	6.50%	8.72%	3.37%	5.69%	5.95%	8.88%
Negative Semi-deviation				6.24%	7.29%	7.21%	9.09%			
Average drawdown				-2.02%	-7.29%	-7.46%	-9.15%			
Maximum drawdown				-9.83%	-15.63%	-17.79%	-22.63%			
% Positive Years	62%	96%	80%	58%	60%	57%	96%	58%	61%	53%
Average Hedge Ratio	100%			53%	51%	51%				
Information Ratio	0.12	12.34	0.66	0.19	0.23	0.17	0.91	0.12	0.16	0.11
Sortino Ratio				0.17	0.21	0.17				
Calmar Ratio				0.08	0.09	0.07				
Average Rolling 1yr Return (Relative to free option)				-2.32%	-2.11%	-2.00%				
Negative Semi-deviation (Relative to free option)				5.22%	5.47%	7.75%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.40%	-2.19%	-2.08%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.91%	5.13%	7.27%				
Turnover				3.12	3.40	17.05				
Trade Size (5th Pctile)				0.61%	15.00%	0.58%				
Trade Size (20th Pctile)				5.06%	15.27%	2.52%				
Trade Size (50th Pctile)				5.42%	15.96%	6.23%				
Trade Size (Average)				5.64%	16.04%	7.62%				
Trade Size (80th Pctile)				6.33%	17.22%	11.50%				
Trade Size (95th Pctile)				11.00%	19.35%	19.57%				
Trade Size (99th Pctile)				13.40%	31.84%	29.28%				

INSIGHT INVESTMENT

Similar to the MSCI weighted results, adding the rebalancing discipline feature to each strategy appears to reduce turnover significantly in both cases. This turnover reduction again appears to make little difference to the summary statistics.

The logical inconsistency with the OBPI-Momentum rebalancing discipline in the context of "separation" that has been referred to earlier in the document becomes apparent in the equally weighted basket case. That is that the momentum signals for each currency pair have the hysteresis bands built in but are then netted of via the AUD after the hysteresis bands have been applied. Following that netting off via the AUD, then the default minimum trade constraint of 5% is applied. It makes no sense to apply the hysteresis bands before netting the exposures for implementation via AUD unless there is some market timing skill associated with these bands which theory and the empirical evidence suggest there isn't.

3.2.4   Time to expiry function

Figure 45 – Cumulative profit/loss from equal weight cross-hedging 21 pairs via AUD
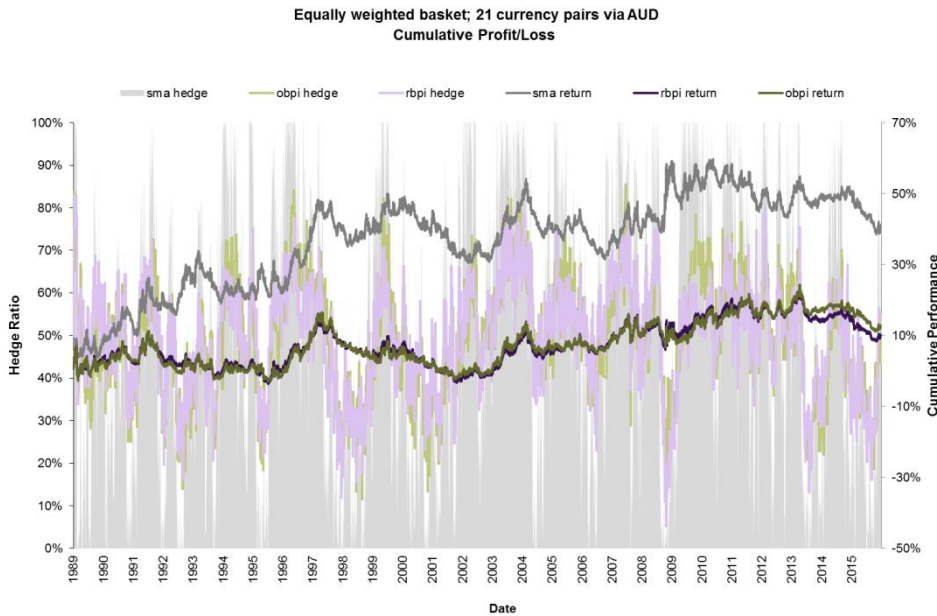
Figure 46 – Difference in aggregate hedge ratio equal weight cross-hedging 21 pairs via AUD

Equally weighted basket; 21 currency pairs via AUD
Hedge Ratio Difference

Figure 47 – Rolling annual Sortino ratio equal weight cross-hedging 21 pairs via AUD

Equally weighted basket; 21 currency pairs via AUD
Rolling Sortino Ratio

Table 35 – Annual absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	2.75%	1.77%	5.66%	2.83%	3.72%	8.58%	4.02%	1.47%	2.35%	7.17%
1990	-6.64%	1.26%	-3.26%	-0.10%	-1.43%	3.95%	0.70%	3.19%	1.87%	7.35%
1991	0.22%	2.44%	4.87%	-0.66%	1.73%	9.10%	4.74%	-0.77%	1.62%	8.99%
1992	-3.13%	0.32%	0.89%	-0.55%	-2.17%	5.21%	2.75%	1.01%	-0.61%	6.81%
1993	-0.68%	0.05%	1.36%	-2.47%	-1.63%	-5.89%	1.76%	-2.13%	-1.29%	-5.54%
1994	6.71%	4.10%	4.18%	2.75%	2.44%	-2.97%	0.18%	-0.58%	-0.89%	-0.46%
1995	-4.33%	0.64%	1.75%	-2.64%	-2.29%	-1.87%	4.34%	-0.49%	-0.14%	0.35%
1996	12.19%	10.96%	11.82%	11.40%	10.21%	18.34%	4.54%	5.35%	4.15%	12.10%
1997	-9.62%	4.38%	0.82%	-3.41%	-2.88%	-0.40%	6.56%	1.36%	1.90%	4.52%
1998	-7.25%	0.00%	-1.98%	-3.37%	-3.72%	-0.09%	2.34%	0.23%	-0.12%	3.62%
1999	8.56%	3.68%	6.56%	3.21%	3.69%	8.83%	1.46%	-1.03%	-0.57%	4.45%
2000	-7.74%	0.68%	-0.11%	-5.12%	-5.74%	-5.69%	4.51%	-1.28%	-1.90%	-1.73%
2001	-1.54%	0.05%	0.86%	-2.57%	-3.85%	-9.77%	1.77%	-1.80%	-3.09%	-8.99%
2002	1.89%	3.36%	1.80%	1.47%	1.25%	0.91%	0.68%	0.53%	0.31%	-0.06%
2003	15.78%	8.18%	15.78%	9.86%	9.99%	14.15%	6.35%	2.03%	2.15%	6.07%
2004	0.89%	6.47%	1.07%	-3.31%	-3.18%	-6.78%	0.53%	-3.75%	-3.62%	-7.23%
2005	3.92%	4.74%	3.92%	0.82%	1.80%	0.53%	1.59%	-1.12%	-0.15%	-1.48%
2006	3.36%	1.16%	3.81%	0.82%	1.44%	-4.91%	1.80%	-0.85%	-0.23%	-6.63%
2007	4.61%	7.14%	4.88%	1.44%	1.02%	-0.78%	2.12%	-0.85%	-1.27%	-0.78%
2008	-13.58%	3.34%	1.90%	1.51%	3.19%	20.22%	10.01%	8.25%	9.94%	27.17%
2009	18.10%	5.20%	14.57%	1.53%	1.21%	-6.74%	3.76%	-7.45%	-7.78%	-16.00%
2010	11.60%	13.13%	11.56%	5.37%	5.57%	6.05%	4.63%	-0.38%	-0.19%	0.12%
2011	2.47%	7.25%	2.44%	-1.38%	-3.93%	-10.22%	0.97%	-2.61%	-5.16%	-11.49%
2012	3.49%	5.15%	3.33%	0.44%	0.88%	-1.01%	1.25%	-1.29%	-0.86%	-2.80%
2013	-10.34%	1.94%	0.21%	-0.22%	-2.84%	2.83%	6.38%	4.91%	2.29%	8.13%
2014	1.04%	0.70%	1.65%	-0.28%	0.53%	0.64%	1.03%	-0.79%	0.01%	0.11%
2015	-4.08%	0.06%	-0.01%	-4.49%	-4.69%	-9.27%	2.42%	-2.47%	-2.66%	-7.18%

Table 36 – Summary statistics for absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	1.06%	3.62%	3.70%	0.48%	0.38%	1.52%	3.07%	-0.05%	-0.14%	0.98%
Median	1.63%	1.63%	2.87%	0.37%	0.39%	1.36%				
Skew	(0.06)	1.57	0.98	0.39	0.32	0.26				
Volatility	9.06%	0.29%	5.58%	5.50%	5.35%	8.72%	3.37%	4.53%	4.52%	8.88%
Negative Semi-deviation			6.24%	6.09%	5.97%	9.09%				
Average drawdown			-2.02%	-8.21%	-7.45%	-9.15%				
Maximum drawdown			-9.83%	-19.01%	-18.10%	-22.63%				
% Positive Years	62%	96%	80%	54%	54%	57%	96%	45%	44%	53%
Average Hedge Ratio	100%			50%	50%	51%				
Information Ratio	0.12	12.34	0.66	0.09	0.07	0.17	0.91	(0.01)	(0.03)	0.11
Sortino Ratio				0.08	0.06	0.17				
Calmar Ratio				0.03	0.02	0.07				
Average Rolling 1yr Return (Relative to free option)				-3.10%	-3.21%	-2.00%				
Negative Semi-deviation (Relative to free option)				4.92%	4.79%	7.75%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-3.18%	-3.29%	-2.08%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.70%	4.46%	7.27%				
Turnover				4.20	4.47	17.05				
Trade Size (5th Pctile)				0.54%	0.68%	0.58%				
Trade Size (20th Pctile)				5.08%	5.08%	2.52%				
Trade Size (50th Pctile)				5.59%	5.62%	6.23%				
Trade Size (Average)				5.64%	5.73%	7.62%				
Trade Size (80th Pctile)				6.61%	6.59%	11.50%				
Trade Size (95th Pctile)				10.60%	10.71%	19.57%				
Trade Size (99th Pctile)				12.93%	13.51%	29.28%				

The results for the "time to expiry" feature are consistent with what has been calculated previously in the MSCI results and there seems to be a substantial worsening of the risk-adjusted returns when considering this feature in isolation. Running these strategies with this constant time to expiry effectively achieves the "benchmark" position, or the buy-and-hold return associated with the neutral 50% hedged position as is evident in the summary statistics for the return relative to the average hedge in Table 17.

3.2.5   Delta adjustment

Figure 48 – Cumulative profit/loss from equal weight cross-hedging 21 pairs via AUD

Figure 49 – Difference in aggregate hedge ratio equal weight cross-hedging 21 pairs via AUD

Figure 50 – Rolling annual Sortino ratio equal weight cross-hedging 21 pairs via AUD
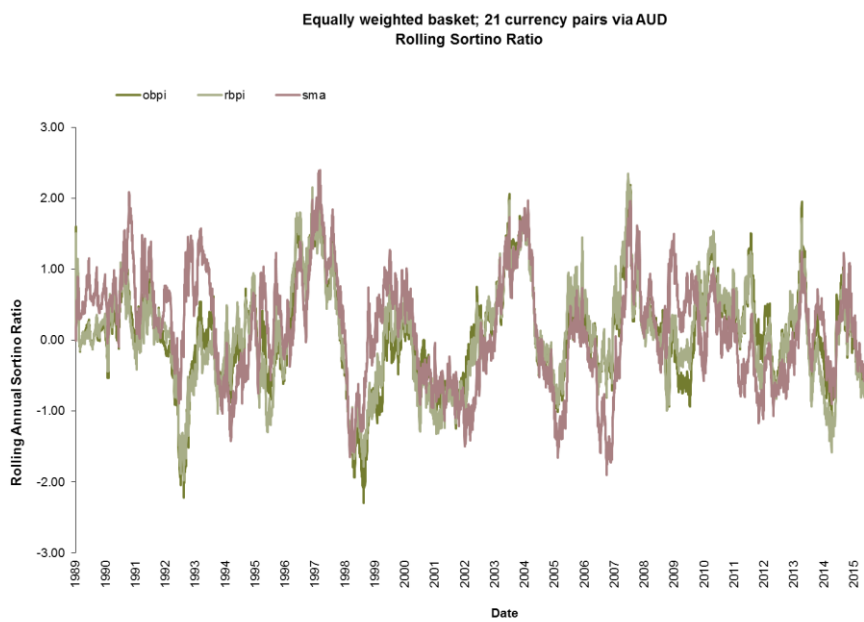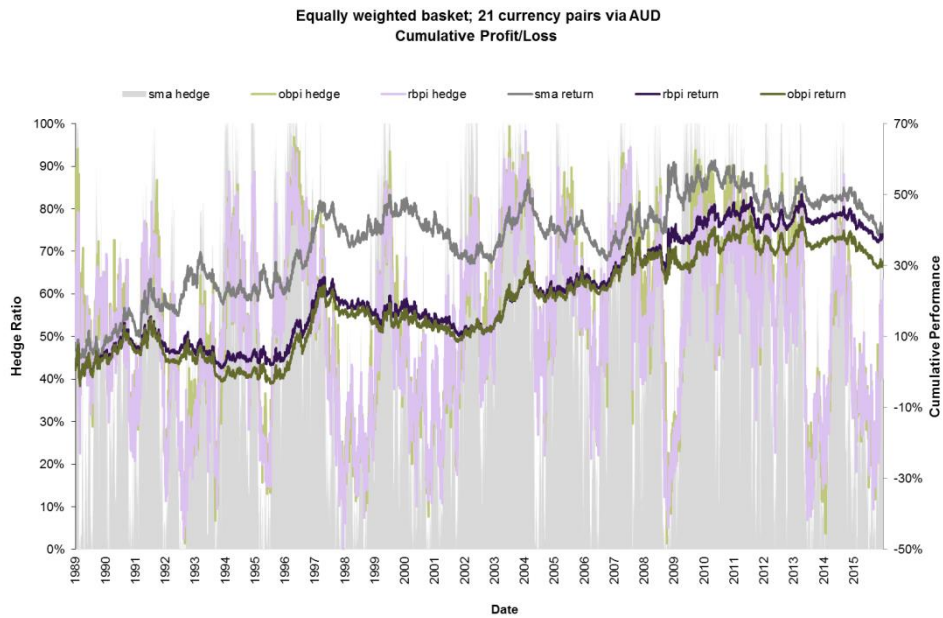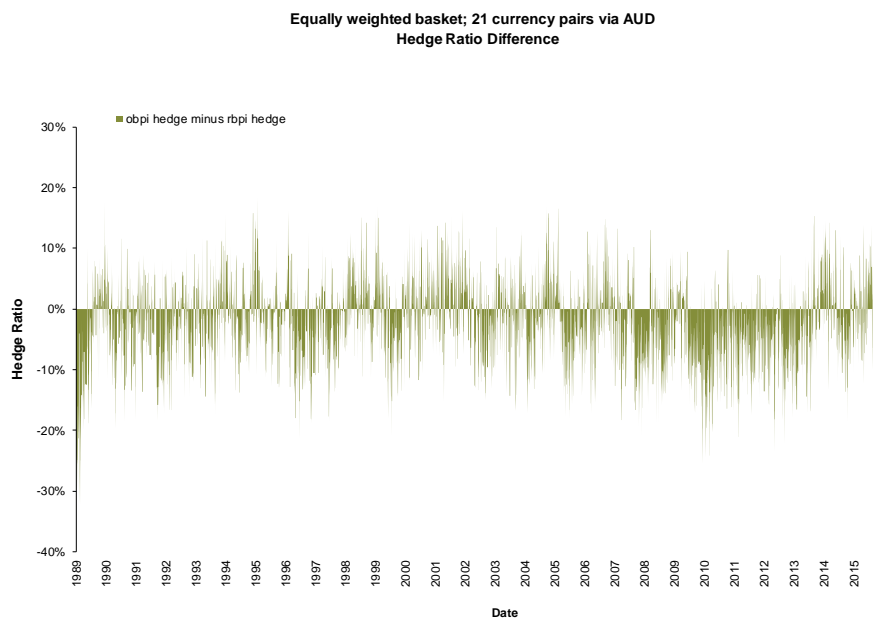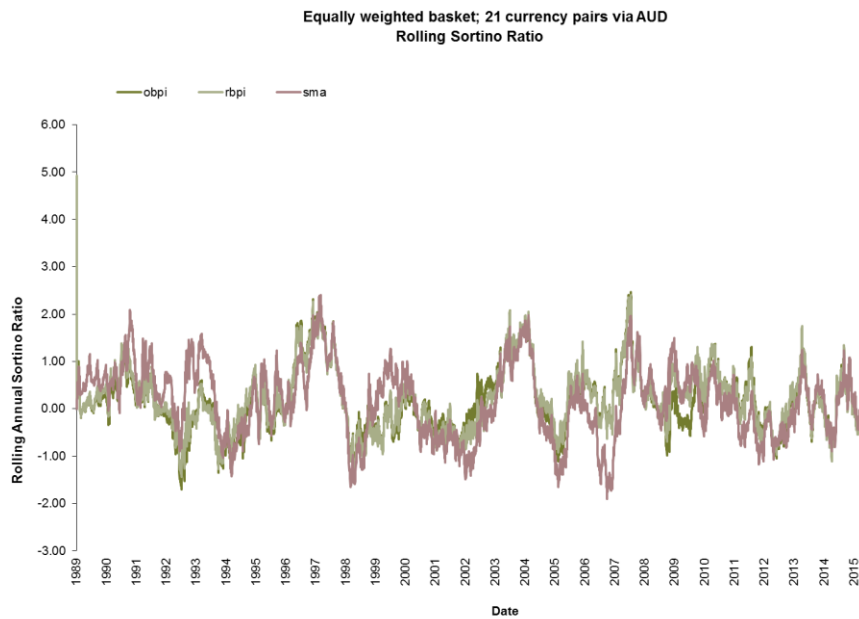

Equally weighted basket; 21 currency pairs via AUD
Rolling Sortino Ratio

Table 37 – Annual absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	2.75%	1.77%	5.66%	4.72%	5.49%	8.58%	4.02%	3.22%	4.06%	7.17%
1990	-6.64%	1.26%	-3.26%	1.06%	1.50%	3.95%	0.70%	4.69%	4.97%	7.35%
1991	0.22%	2.44%	4.87%	-1.02%	1.00%	9.10%	4.74%	-1.15%	0.89%	8.99%
1992	-3.13%	0.32%	0.89%	-0.85%	-1.76%	5.21%	2.75%	0.86%	-0.12%	6.81%
1993	-0.68%	0.05%	1.36%	-5.88%	-4.05%	-5.89%	1.76%	-5.51%	-3.69%	-5.54%
1994	6.71%	4.10%	4.18%	2.93%	3.48%	2.97%	0.18%	-0.74%	-0.02%	-0.46%
1995	-4.33%	0.64%	1.75%	-1.41%	-1.62%	-1.87%	4.34%	0.96%	0.64%	0.35%
1996	12.19%	10.96%	11.82%	17.94%	15.97%	18.34%	4.54%	11.28%	9.60%	12.10%
1997	-9.62%	4.38%	0.82%	-0.70%	-0.59%	-0.40%	6.56%	4.56%	4.44%	4.52%
1998	-7.25%	0.00%	-1.98%	-2.57%	-3.03%	-0.09%	2.34%	1.39%	0.76%	3.62%
1999	8.56%	3.68%	6.56%	3.49%	4.02%	8.83%	1.46%	-1.19%	-0.45%	4.45%
2000	-7.74%	0.68%	-0.11%	-4.73%	-5.56%	-5.69%	4.51%	-0.50%	-1.51%	-1.73%
2001	-1.54%	0.05%	0.86%	-2.35%	-3.27%	-9.77%	1.77%	-1.51%	-2.47%	-8.99%
2002	1.89%	3.36%	1.80%	2.93%	2.02%	0.91%	0.68%	1.90%	1.03%	-0.06%
2003	15.78%	8.18%	15.78%	12.74%	12.45%	14.15%	6.35%	4.11%	4.19%	6.07%
2004	0.89%	6.47%	1.07%	-3.93%	-2.34%	-6.78%	0.53%	-4.42%	-2.81%	-7.23%
2005	3.92%	4.74%	3.92%	3.35%	3.33%	0.53%	1.59%	1.21%	1.29%	-1.48%
2006	3.36%	1.16%	3.81%	2.07%	1.89%	-4.91%	1.80%	0.24%	0.14%	-6.63%
2007	4.61%	7.14%	4.88%	3.22%	2.39%	1.58%	2.12%	0.70%	-0.02%	-0.78%
2008	-13.58%	3.34%	1.90%	3.62%	8.99%	20.22%	10.01%	11.05%	16.09%	27.17%
2009	18.10%	5.20%	14.57%	-0.07%	1.27%	-6.74%	3.76%	-9.96%	-8.20%	-16.00%
2010	11.60%	13.13%	11.56%	6.64%	6.17%	6.05%	4.63%	0.30%	0.11%	0.12%
2011	2.47%	7.25%	2.44%	-5.49%	-5.82%	-10.22%	0.97%	-6.84%	-7.11%	-11.49%
2012	3.49%	5.15%	3.33%	0.37%	1.20%	-1.01%	1.25%	-1.54%	-0.63%	-2.80%
2013	-10.34%	1.94%	0.21%	1.48%	0.77%	2.83%	6.38%	7.14%	6.18%	8.13%
2014	1.04%	0.70%	1.65%	0.16%	0.16%	0.64%	1.03%	-0.41%	-0.39%	0.11%
2015	-4.08%	0.06%	-0.01%	-6.66%	-5.28%	-9.27%	2.42%	-4.44%	-3.15%	-7.18%

Table 38 – Summary statistics for absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	1.06%	3.62%	3.70%	1.15%	1.43%	1.52%	3.07%	0.57%	0.88%	0.98%
Median	1.63%	1.63%	2.87%	0.69%	0.99%	1.36%				
Skew	(0.06)	1.57	0.98	0.78	0.69	0.26				
Volatility	9.06%	0.29%	5.58%	7.08%	6.62%	8.72%	3.37%	6.46%	6.20%	8.88%
Negative Semi-deviation			6.24%	7.80%	7.25%	9.09%				
Average drawdown			-2.02%	-8.02%	-7.03%	-9.15%				
Maximum drawdown			-9.83%	-18.54%	-16.68%	-22.63%				
% Positive Years	62%	96%	80%	55%	58%	57%	96%	57%	55%	53%
Average Hedge Ratio	100%			55%	52%	51%				
Information Ratio	0.12	12.34	0.66	0.16	0.22	0.17	0.91	0.09	0.14	0.11
Sortino Ratio				0.15	0.20	0.17				
Calmar Ratio				0.06	0.09	0.07				
Average Rolling 1yr Return (Relative to free option)				-2.41%	-2.16%	-2.00%				
Negative Semi-deviation (Relative to free option)				5.47%	5.14%	7.75%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.49%	-2.24%	-2.08%				
Negative Semi-deviation (Relative to investable perfect hedge)				5.11%	4.60%	7.27%				
Turnover				6.19	6.52	17.05				
Trade Size (5th Pctile)				0.51%	0.54%	0.58%				
Trade Size (20th Pctile)				4.97%	5.02%	2.52%				
Trade Size (50th Pctile)				5.69%	5.76%	6.23%				
Trade Size (Average)				5.79%	5.87%	7.62%				
Trade Size (80th Pctile)				7.21%	7.25%	11.50%				
Trade Size (95th Pctile)				11.57%	11.45%	19.57%				
Trade Size (99th Pctile)				14.81%	14.97%	29.28%				

The "delta adjustment" feature doesn't perform as well as in the MSCI World examples, but again its impact is marginal. However, this equally weighted, cross hedging case provides another example of the logical inconsistency with the OBPI-Momentum in the context of "separation" that was alluded to in the discussion around the MSCI World results. That is that the momentum signals for each currency pair have the NME built in but are then netted of via the AUD after the NME has been applied. Following that netting off of the cross currency positions via the AUD, the purpose of the NME is defeated.

3.2.6   Risk estimation

Figure 51 – Cumulative profit/loss from equal weight cross-hedging 21 pairs via AUD
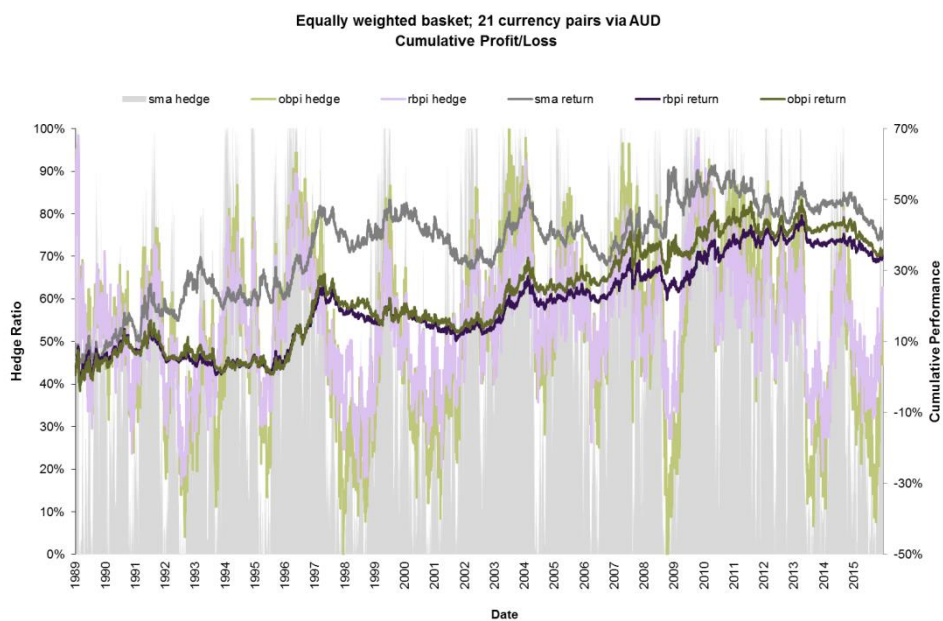
Figure 52 – Difference in aggregate hedge ratio equal weight cross-hedging 21 pairs via AUD
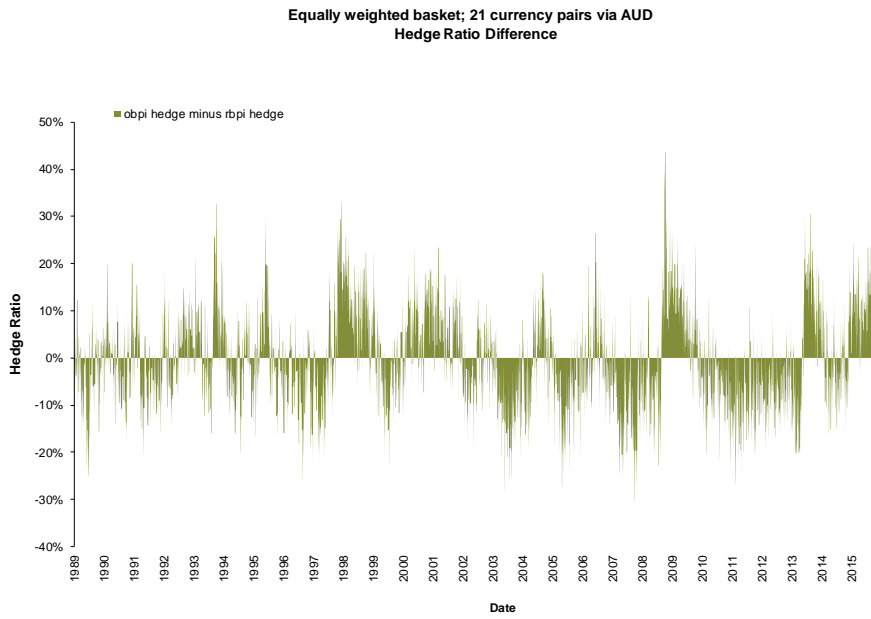
Equally weighted basket; 21 currency pairs via AUD
Hedge Ratio Difference

Figure 53 – Rolling annual Sortino ratio equal weight cross-hedging 21 pairs via AUD

Equally weighted basket; 21 currency pairs via AUD
Rolling Sortino Ratio

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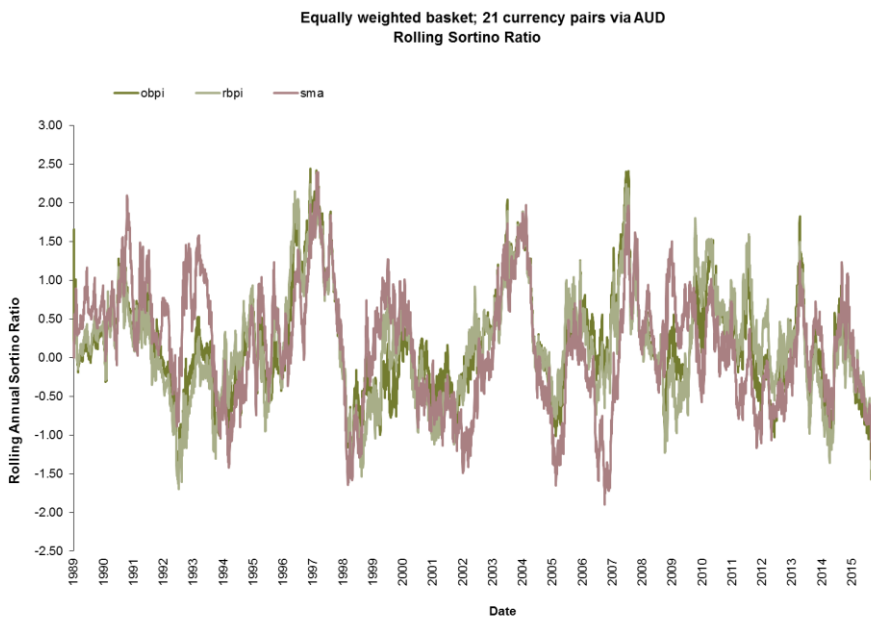
Table 39 – Annual absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Annual Returns	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
1989	2.75%	1.77%	5.66%	5.23%	6.06%	8.58%	4.02%	3.74%	4.58%	7.17%
1990	-6.64%	1.26%	-3.26%	1.49%	1.12%	3.95%	0.70%	5.09%	4.69%	7.35%
1991	0.22%	2.44%	4.87%	-0.35%	-1.71%	9.10%	4.74%	-0.47%	-1.83%	8.99%
1992	-3.13%	0.32%	0.89%	-0.17%	-1.33%	5.21%	2.75%	1.52%	0.36%	6.81%
1993	-0.68%	0.05%	1.36%	-4.35%	-1.71%	-5.89%	1.76%	-3.98%	-1.35%	-5.54%
1994	6.71%	4.10%	4.18%	3.66%	3.27%	2.97%	0.18%	0.02%	-0.34%	-0.46%
1995	-4.33%	0.64%	1.75%	-1.97%	-1.09%	-1.87%	4.34%	0.38%	1.24%	0.35%
1996	12.19%	10.96%	11.82%	18.01%	15.04%	18.34%	4.54%	11.38%	8.48%	12.10%
1997	-9.62%	4.38%	0.82%	-1.07%	-1.82%	-0.40%	6.56%	4.16%	3.35%	4.52%
1998	-7.25%	0.00%	-1.98%	-2.83%	-2.61%	-0.09%	2.34%	1.11%	1.29%	3.62%
1999	8.56%	3.68%	6.56%	3.03%	4.89%	8.83%	1.46%	-1.62%	0.28%	4.45%
2000	-7.74%	0.68%	-0.11%	-4.58%	-5.51%	-5.69%	4.51%	-0.38%	-1.34%	-1.73%
2001	-1.54%	0.05%	0.86%	-1.34%	-1.64%	-9.77%	1.77%	-0.50%	-0.81%	-8.99%
2002	1.89%	3.36%	1.80%	2.20%	1.55%	0.91%	0.68%	1.17%	0.53%	-0.06%
2003	15.78%	8.18%	15.78%	12.04%	10.11%	14.15%	6.35%	3.46%	1.61%	6.07%
2004	0.89%	6.47%	1.07%	-2.94%	-2.32%	-6.78%	0.53%	-3.42%	-2.80%	-7.23%
2005	3.92%	4.74%	3.92%	2.64%	1.88%	0.53%	1.59%	0.51%	-0.23%	-1.48%
2006	3.36%	1.16%	3.81%	3.04%	1.77%	-4.91%	1.80%	1.21%	-0.04%	-6.63%
2007	4.61%	7.14%	4.88%	2.85%	2.27%	1.58%	2.12%	0.34%	-0.21%	-0.78%
2008	-13.58%	3.34%	1.90%	4.17%	-0.33%	20.22%	10.01%	11.55%	6.98%	27.17%
2009	18.10%	5.20%	14.57%	1.23%	5.45%	-6.74%	3.76%	-8.61%	-4.30%	-16.00%
2010	11.60%	13.13%	11.56%	7.39%	6.89%	6.05%	4.63%	1.09%	0.65%	0.12%
2011	2.47%	7.25%	2.44%	-5.50%	-0.96%	-10.22%	0.97%	-6.84%	-2.29%	-11.49%
2012	3.49%	5.15%	3.33%	0.54%	0.40%	-1.01%	1.25%	-1.36%	-1.48%	-2.80%
2013	-10.34%	1.94%	0.21%	0.41%	-1.64%	2.83%	6.38%	6.03%	3.93%	8.13%
2014	1.04%	0.70%	1.65%	0.09%	-0.28%	0.64%	1.03%	-0.48%	-0.84%	0.11%
2015	-4.08%	0.06%	-0.01%	-7.13%	-3.31%	-9.27%	2.42%	-4.92%	-1.12%	-7.18%

Table 40 – Summary statistics for absolute/relative return for equal weight cross-hedging 21pairs via AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	1.06%	3.62%	3.70%	1.32%	1.27%	1.52%	3.07%	0.75%	0.70%	0.98%
Median	1.63%	1.63%	2.87%	0.74%	0.70%	1.36%				
Skew	(0.06)	1.57	0.98	0.84	0.71	0.26				
Volatility	9.06%	0.29%	5.58%	6.94%	5.75%	8.72%	3.37%	6.35%	3.98%	8.88%
Negative Semi-deviation			6.24%	7.66%	6.41%	9.09%				
Average drawdown			-2.02%	-7.68%	-6.38%	-9.15%				
Maximum drawdown			-9.83%	-16.45%	-15.36%	-22.63%				
% Positive Years	62%	96%	80%	57%	57%	57%	96%	57%	56%	53%
Average Hedge Ratio	100%			54%	54%	51%				
Information Ratio	0.12	12.34	0.66	0.19	0.22	0.17	0.91	0.12	0.18	0.11
Sortino Ratio				0.17	0.20	0.17				
Calmar Ratio				0.08	0.08	0.07				
Average Rolling 1yr Return (Relative to free option)				-2.23%	-2.33%	-2.00%				
Negative Semi-deviation (Relative to free option)				5.19%	4.07%	7.75%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.31%	-2.41%	-2.08%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.81%	3.77%	7.27%				
Turnover				5.69	4.28	17.05				
Trade Size (5th Pctile)				0.52%	0.70%	0.58%				
Trade Size (20th Pctile)				5.06%	5.09%	2.52%				
Trade Size (50th Pctile)				5.65%	5.55%	6.23%				
Trade Size (Average)				5.81%	5.73%	7.62%				
Trade Size (80th Pctile)				7.00%	6.55%	11.50%				
Trade Size (95th Pctile)				11.14%	10.64%	19.57%				
Trade Size (99th Pctile)				14.43%	13.50%	29.28%				

Even in this case we can't find any substantial benefit in changing the volatility estimates.

3.2.7 Live strategy

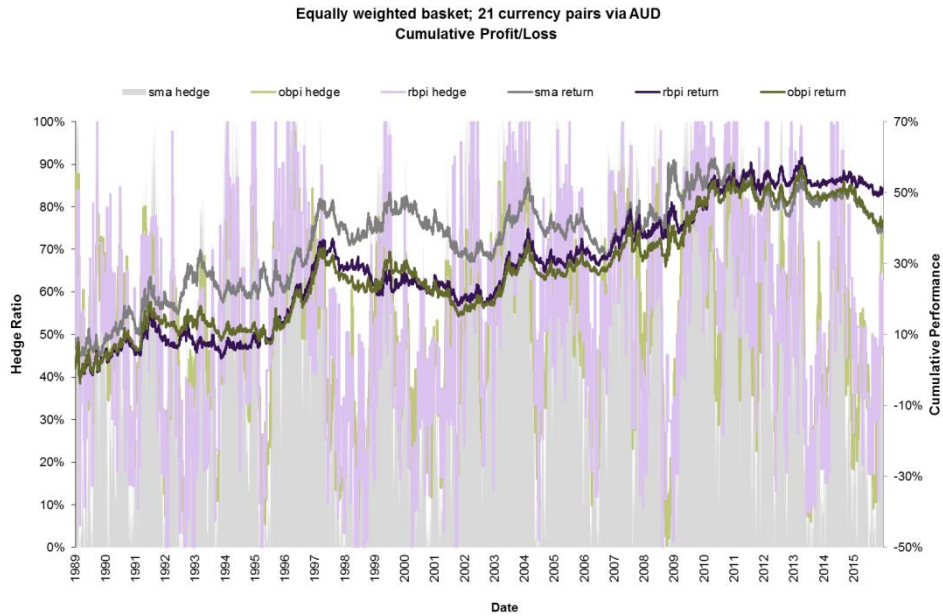Figure 54 – Cumulative profit/loss from equal weight cross-hedging 21 pairs via AUD

Figure 55 – Difference in aggregate hedge ratio equal weight cross-hedging 21 pairs via AUD
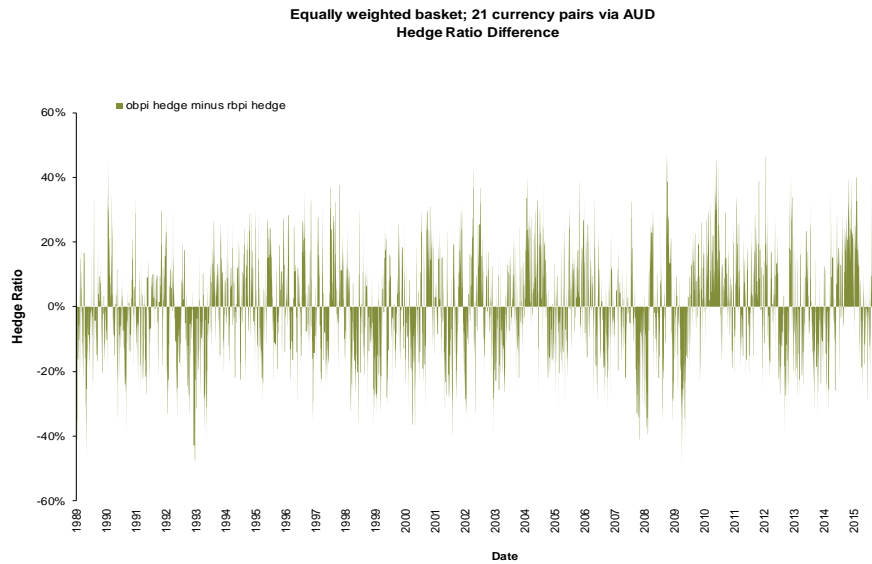
Figure 55 – Rolling annual Sortino ratio equal weight cross-hedging 21 pairs via AUD
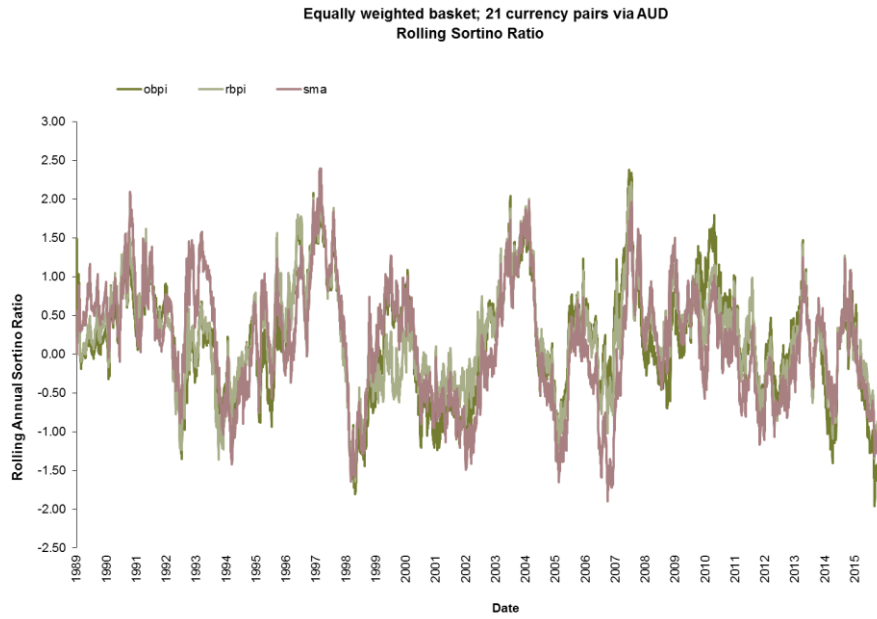

Equally weighted basket; 21 currency pairs via AUD
Rolling Sortino Ratio

Table 41 – Annual absolute/relative return for equal weight cross-hedging 21 pairs via AUD

Annual Returns		passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
				perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
	1989	2.75%	1.77%	5.66%	4.48%	4.87%	8.58%	4.02%	3.02%	3.40%	7.17%
	1990	-6.64%	1.26%	-3.26%	1.60%	-0.51%	3.95%	0.70%	5.14%	3.03%	7.35%
	1991	0.22%	2.44%	4.87%	9.15%	5.19%	9.10%	4.74%	9.04%	5.08%	8.99%
	1992	-3.13%	0.32%	0.89%	-1.43%	-2.54%	5.21%	2.75%	0.24%	-0.87%	6.81%
	1993	-0.68%	0.05%	1.36%	-3.38%	-2.13%	-5.89%	1.76%	-3.02%	-1.77%	-5.54%
	1994	6.71%	4.10%	4.18%	2.05%	4.74%	2.97%	0.18%	-1.53%	1.16%	-0.46%
	1995	-4.33%	0.64%	1.75%	0.32%	3.74%	-1.87%	4.34%	2.63%	6.05%	0.35%
	1996	12.19%	10.96%	11.82%	14.84%	17.04%	18.34%	4.54%	8.34%	10.53%	12.10%
	1997	-9.62%	4.38%	0.82%	-1.39%	-1.97%	-0.40%	6.56%	3.74%	3.17%	4.52%
	1998	-7.25%	0.00%	-1.98%	-3.38%	-4.39%	-0.09%	2.34%	0.48%	-0.53%	3.62%
	1999	8.56%	3.68%	6.56%	7.71%	3.72%	8.83%	1.46%	3.15%	-0.85%	4.45%
	2000	-7.74%	0.68%	-0.11%	-7.33%	-3.01%	-5.69%	4.51%	-3.21%	1.12%	-1.73%
	2001	-1.54%	0.05%	0.86%	-6.25%	-3.94%	-9.77%	1.77%	-5.43%	-3.12%	-8.99%
	2002	1.89%	3.36%	1.80%	1.97%	1.11%	0.91%	0.68%	0.96%	0.10%	-0.06%
	2003	15.78%	8.18%	15.78%	12.66%	11.33%	14.15%	6.35%	4.25%	2.91%	6.07%
	2004	0.89%	6.47%	1.07%	-3.34%	-1.24%	-6.78%	0.53%	-3.81%	-1.72%	-7.23%
	2005	3.92%	4.74%	3.92%	2.08%	1.96%	0.53%	1.59%	-0.00%	-0.13%	-1.48%
	2006	3.36%	1.16%	3.81%	2.03%	2.40%	-4.91%	1.80%	0.24%	0.61%	-6.63%
	2007	4.61%	7.14%	4.88%	-0.87%	1.38%	1.58%	2.12%	-3.33%	-1.09%	-0.78%
	2008	-13.58%	3.34%	1.90%	9.12%	8.24%	20.22%	10.01%	16.35%	15.48%	27.17%
	2009	18.10%	5.20%	14.57%	5.92%	0.15%	-6.74%	3.76%	-3.72%	-9.51%	-16.00%
	2010	11.60%	13.13%	11.56%	7.50%	10.11%	6.05%	4.63%	1.32%	3.92%	0.12%
	2011	2.47%	7.25%	2.44%	-4.91%	-3.48%	-10.22%	0.97%	-6.23%	-4.80%	-11.49%
	2012	3.49%	5.15%	3.33%	1.21%	1.27%	-1.01%	1.25%	-0.65%	-0.60%	-2.80%
	2013	-10.34%	1.94%	0.21%	-1.11%	-0.38%	2.83%	6.38%	4.40%	5.14%	8.13%
	2014	1.04%	0.70%	1.65%	1.23%	0.22%	0.64%	1.03%	0.67%	-0.34%	0.11%
	2015	-4.08%	0.06%	-0.01%	-8.27%	-2.50%	-9.27%	2.42%	-6.10%	-0.33%	-7.18%

INSIGHT INVESTMENT

Table 42 – Summary statistics for absolute/relative return for equal weight cross-hedging 21pairs via AUD

Summary Statistics - 1989 to 2015	passive fully hedged	free option	Absolute strategy return				Relative to average hedge			
			perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return	perfect hedge (rolling 1 yr)	obpi return	rbpi return	sma return
Annualised Return	1.06%	3.62%	3.70%	1.56%	1.90%	1.52%	3.07%	0.99%	1.33%	0.98%
Median	1.63%	1.63%	2.87%	1.40%	1.13%	1.36%				
Skew	(0.06)	1.57	0.98	0.38	0.76	0.26				
Volatility	9.06%	0.29%	5.58%	7.16%	7.06%	8.72%	3.37%	6.63%	6.27%	8.88%
Negative Semi-deviation			6.24%	7.79%	7.77%	9.09%				
Average drawdown			-2.02%	-6.93%	-7.23%	-9.15%				
Maximum drawdown			-9.83%	-19.17%	-19.26%	-22.63%				
% Positive Years	62%	96%	80%	60%	62%	57%	96%	58%	62%	53%
Average Hedge Ratio	100%			53%	53%	51%				
Information Ratio	0.12	12.34	0.66	0.22	0.27	0.17	0.91	0.15	0.21	0.11
Sortino Ratio				0.20	0.24	0.17				
Calmar Ratio				0.08	0.10	0.07				
Average Rolling 1yr Return (Relative to free option)				-1.98%	-1.72%	-2.00%				
Negative Semi-deviation (Relative to free option)				5.15%	4.89%	7.75%				
Average Rolling 1yr Return (Relative to investable perfect hedge)				-2.06%	-1.79%	-2.08%				
Negative Semi-deviation (Relative to investable perfect hedge)				4.71%	4.45%	7.27%				
Turnover				5.46	7.25	17.05				
Trade Size (5th Pctile)				0.56%	2.54%	0.58%				
Trade Size (20th Pctile)				5.03%	15.28%	2.52%				
Trade Size (50th Pctile)				5.54%	16.38%	6.23%				
Trade Size (Average)				5.86%	16.53%	7.62%				
Trade Size (80th Pctile)				7.06%	18.53%	11.50%				
Trade Size (95th Pctile)				11.76%	23.25%	19.57%				
Trade Size (99th Pctile)				15.51%	35.01%	29.28%				

The live strategy simulation shown above is a representation of what we are running in our live hedging overlays (OBPI-Momentum in North America and UK and RBPI-Momentum in Australia), the only difference being the cross-currency positions are all netted via AUD before implementing and the minimum trade limits apply to the net implementation like they would for each single currency signal in a hedging overlay.

Again there isn't a significant difference between them, both in a statistical sense and from a practical point of view. At the margin, if our choice is to be a strictly objective one based on the relevant summary statistics like risk-adjusted return, deviation from the free option and turnover one would choose RBPI-Momentum over OBPI-Momentum. However any choice between them has to be mostly a subjective one given how small the differences are between them and may come down to a matter of preference.

As with the MSCI World results, we see the full effect of the rebalancing discipline, time to expiry and risk estimation features of each strategy operating together. It is the combination of the time to expiry function and the risk estimation that add the most value for the RBPI-Momentum and the 15% minimum trade constraint acts to effectively reduce turnover such that it is similar to that of OBPI-Momentum while still maintaining an advantage in terms of risk-adjusted return.

For the equally weighted, cross hedging example like with the MSCI World weighted example there is little difference in terms of risk-adjusted return for OBPI-Momentum over the base case. However, given that we have shown that the OBPI and RBPI base cases are equivalent at the start we should be able to substitute the OBPI-Momentum features with those of RBPI-Momentum (such as the short term RiskMetrics volatility estimate, constant time to expiry etc.) and achieve the same improvement with OBPI-Momentum relative to the base case.

The other interesting findings is that the equally weighted results have been corroborated by MSCI tracking basket weighted ones which are ultimately in line with theory and give us a greater confidence in the conclusions we draw from the data.

4   Conclusion

The results of this analysis suggest that, for the purposes of achieving the return and payoff properties associated with a momentum strategy both momentum models are equivalent. There is perhaps some value added by the features currently associated with RBPI-Momentum like the "rebalancing discipline" and the" risk estimation" in combination with the "time to expiry" feature but these features can be added to either strategy as they are independent of the base strategy they're applied to. Whilst differences between the candidate momentum strategies are time-varying and vary by currency pair, in the grand scheme of things and in aggregate they are marginal, both with respect to each other and with respect to the base case.

Historically, the choice of the "best momentum strategy" has implied a belief that these marginal differences reflect an advantage one strategy has over another in exploiting perceived structural inefficiencies that we expect to persist in the future. This belief is a major reason why substantial research effort is spent on refining the momentum strategy – the combination of features one can add to the base strategy; the choice of base strategy; and the set of currency pairs makes for a huge search space. Essentially, making a decision about which of these momentum strategies to run simply based on the marginal differences in results obtained from simulations over this arbitrary historical sample, is like taking a bet on whether we think purchasing one set of options is going to be better value-for-money than another very similar set, forever in the future. Even if by some miracle we get the bet right, will anyone really care?

The trouble with such a fatalistic conclusion is that we're left with no way to objectively choose between either form of momentum strategy. We are left having to make a subjective assessment that considers qualitative factors like: relative parsimony; modularity; generality; the dollar value of assets overlaid; client sensitivity; or ease of implementation. It can be argued that the RBPI base strategy, being the incumbent strategy, is what Pareto has historically been most familiar with. It can also be argued that the RBPI-Momentum is considerably more parsimonious, and its construction is logically more consistent with a broader application in a multi-factor portfolio like FNA especially given how the rebalancing discipline and delta-adjustment features are built directly into the OBPI-Momentum signals. On the other hand it can be argued that OBPI-Momentum is the more general of the two as it is options based and has a more obvious relationship to tradable options. The question then is how much of this generality is lost in the live OBPI-Momentum implementation with all the additional features.

Ultimately, a subjective assessment like this is beyond the scope of this report and needs to involve all stakeholders. Our recommendation is therefore that all stakeholders score each strategy based on the list of qualitative categories above and arrive at a decision by considering the consensus scores for each of these categories in conjunction with the results contained in this report.

What we can conclude is that deciding precisely which momentum strategy to bet on at any point in time is difficult to do and offers a low marginal return to effort. Perhaps it is enough to simply define the momentum process in a well-reasoned, theoretically sound fashion that doesn't require extensive analysis and be done.