RISK-ON RISK-OFF: *Implications for investors in the Australian stock and bond markets*

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Risk-on risk-off (RORO) effects were present in Australian and international financial markets from July 2007 to December 2012. This study shows that a risk-parity portfolio which combines both equities and bonds generates a higher Sharpe ratio than investing in either equities or bonds alone over a sample period incorporating both RORO and non-RORO periods. An earlier version of the paper was presented to the 2013 Australian Centre for Financial Studies' Melbourne Money and Finance Conference.[1]

Risk-on risk-off is a state of financial markets in which many market participants are either risk averse and sell off risky assets such as equities to buy safe assets such as bonds ('risk-off'), or less risk-averse and willing to invest in risky assets such as equities by selling off safe assets such as bonds. The RORO paradigm is a relatively new interpretation of financial market behaviour. It assumes that, as well as normal times, there are periods in which investors are either very risk averse and buy safe assets such as bonds funded by the sale of risky assets such as shares, or less risk averse and buy riskier assets such as shares funded by the sale of bonds.[2] The RORO phenomenon occurs when investors are uncertain about economic recovery and hence oscillate easily between risk-on and risk-off if good or bad news is received about a future recovery (Oliver 2013). Such economic conditions appear to have been present in the world economy from July 2007 onwards, covering the period of the global financial crisis and then the eurozone crisis (HSBC Global Research 2010 and 2012; Oliver 2013).

Lee (2012) argues that in risk-on risk-off conditions active fund managers who focus on stock-picking and estimating idiosyncratic risk would struggle to evaluate stocks accurately as macroeconomic factors and not firm-specific factors explain most of the volatility seen in stock returns. 'Similarly the exposure of equity fund managers to cash should decrease or increase respectively if a risk-on or risk-off period is anticipated' (HSBC 2012). In fact, Saft (2013) argues that risk-on risk-off has caused most professional investors to '[turn] into … global macro hedge fund manager(s), regardless of job description'.

In this study we look at past Australian and international stock and bond return data to identify when risk-on and risk-off periods have occurred and how the Australian stock and bond markets have performed at those times. We then describe a trading strategy known as risk-parity trading that appears to have delivered strong risk-adjusted returns in risk-on risk-off markets.

The implications of RORO for investors

Returns to risky or risk-on assets become strongly positively correlated during risk-off and risk-on states as investors switch between safe and risky assets. Returns to safe or 'risk-off' assets also become strongly positively correlated during 'risk-off' and 'risk-on' states. The correlation between risky asset returns and safe asset returns, however, becomes more negative in 'risk-on' or 'risk-off' states as portfolio shifts cause equity and bond prices to move inversely.

An important implication of the RORO paradigm is the lack of diversification options within an asset class in such a period, which makes returns within an asset class more volatile. One way to alleviate this problem is to have exposure to both bonds and equities, which is illustrated later in this paper via the risk-parity portfolio. From an equity-only manager's point of view, a key consideration then involves forecasting when risk-on or risk-off phases might occur and altering stock market exposure accordingly.

Risk-on risk-off also affects active managers because stock returns in such periods are dominated by macroeconomic and not firm-specific factors. Picking undervalued or overvalued stocks then becomes more difficult. Finally, strategies such as the carry trade and long/short strategies also have exposure to the RORO factor as there are risk-on and risk-off currencies and risk-on and risk-off sectors (HSBC 2012).

Determining RORO and non-RORO periods

Figure 1 shows the average correlations for weekly local currency returns for a set of government bonds (US, UK, Japanese, Australian and European Monetary Union 10-year government bonds) and for a set of equity market indices (ASX 500, Russell 2000, FTSE 100, Nikkei 225, Eurostoxx 50, Dax 30 and the S&P/ASX 200). The sample period is from April 2002 to April 2013 and the correlations are calculated using a rolling 52-week window.[3] Using local currency returns (rather than conversion back into Australian dollar returns) implicitly assumes that risk-on risk-off is a global phenomenon that affects all developed markets simultaneously.

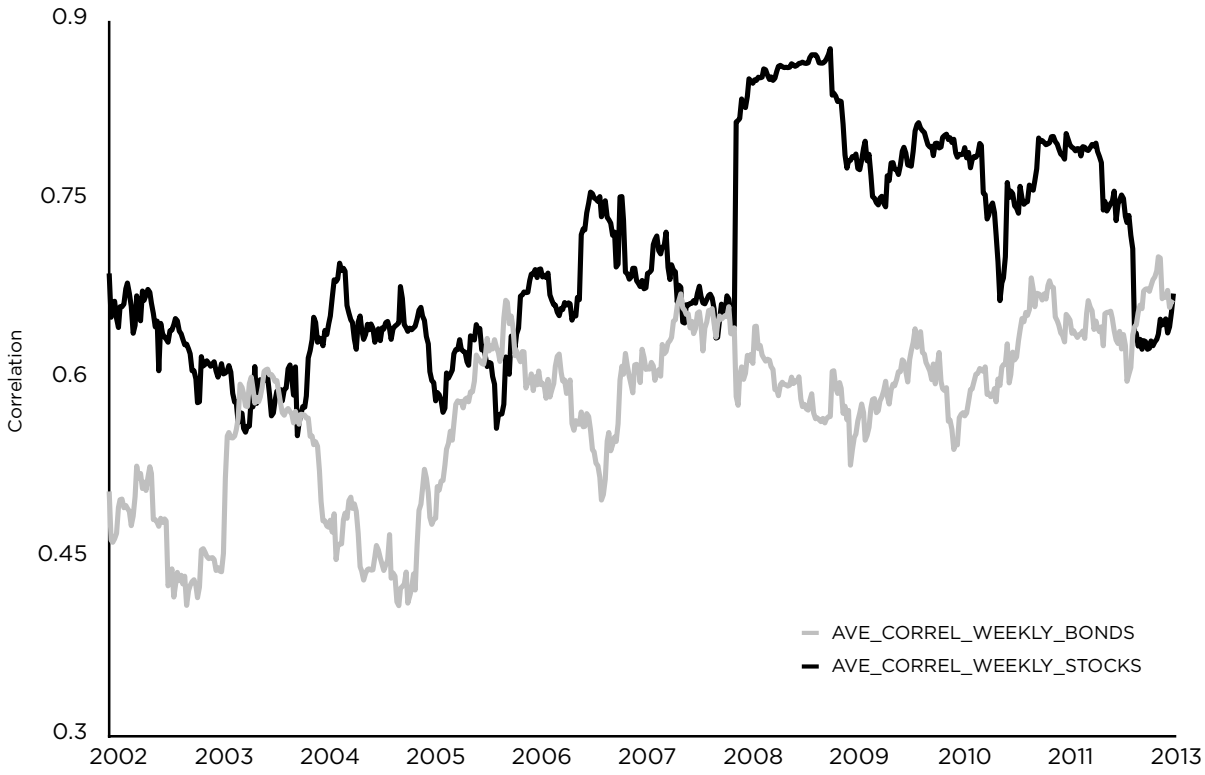
Intra-stock correlations rose significantly around October 2008 when the global financial crisis hit and have only recently returned to pre-crisis levels. Intra-bond correlations have risen over time and stayed at very high levels since the global financial crisis. This is because the central banks of the United States, the United Kingdom and the European Central Bank have all pursued similar interest rate policies during this time, in order to stimulate economic growth.

Figure 2 below shows the risk-on, risk-off and non-RORO periods in our sample,[4] based on a cumulative summation technique (described below) starting at zero. If a risk-off period is identified, the cumulative sum is reduced by one and if a risk-on period is identified, the cumulative sum is increased by one. If a non-RORO period is observed, the cumulative sum remains unchanged.

We define a 'normal' or 'non-RORO' week to occur when either or both the average intra-bond correlation and the average intra-equity correlation falls below their respective long-term averages. A 'risk-on risk-off' or 'RORO' week occurs when both intra-equity and intra-bond correlations exceed their long-term average over the full sample period. A 'RORO' week is then classified as either 'risk-on', when the average return to our equity indices exceeds the average return to our bond indices, or 'risk-off (where the average return to bonds exceeds the average return to equities). Out of a total of 578 weeks from April 2002 to April 2013, 225 are RORO and 353 are non-RORO. Within the RORO weeks, there are 115 risk-on and 110 risk-off.[5]

In our sample period, normal or non-RORO conditions apply from April 2002 to February 2007. From February 2007 to June 2009, the market is essentially risk-off as investors try to interpret the early information on the sub-prime crisis (February 2007 to January 2008 and then react to the Lehman Brothers collapse on 15 September 2008) and the implications of this for financial markets.[6]

FIGURE 1: Rolling correlations within bonds and stocks. The figure shows the average correlation between the bonds in our sample (Ave_Correl_Weekly_Bonds) and the average correlation between the equity indices (Ave_Correl_Weekly_Stocks) in our sample where the correlations are calculated on a rolling window of 52 weeks.



Returns to risky or risk-on assets become strongly positively correlated during risk-off and risk-on states as investors switch between safe and risky assets. Returns to safe or 'risk-off' assets also become strongly positively correlated during 'risk-off' and 'risk-on' states. The correlation between risky asset returns and safe asset returns, however, becomes more negative in 'risk-on' or 'risk-off' states as portfolio shifts cause equity and bond prices to move inversely.

From that point markets switch into a 'risk-on' phase that lasts until the end of April 2011. This period coincides with a series of interest rate cuts around the world to stimulate economic growth as well as various quantitative easing strategies being implemented in the United States and the United Kingdom.[7] Thereafter, a series of risk-off weeks begins, culminating in a low for cumulative risk in mid-August 2011. This period pertains to worries about the extent of the eurozone crisis and worries about the US defaulting on its debt due to protracted debt ceiling negotiations (Lee 2012). From that point, there is some volatility in 'risk-on' and 'risk-off' in response to ongoing uncertainty associated with the eurozone crisis.[8] Finally, from December 2012 onwards, the markets seem to have stabilised and we appear to have entered more normal market conditions.[9]

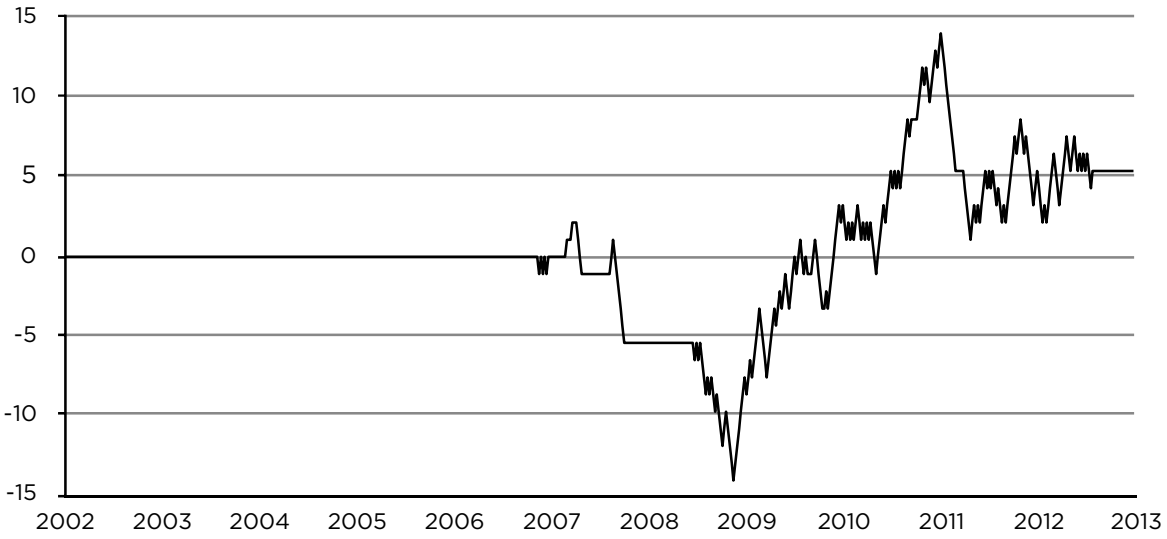
The performance of the Australian equity and bond markets during RORO vs non-RORO periods

Table 1 shows the average returns and standard deviation of returns for the S&P/ASX 200 and an Australian Government Bond Index in non-RORO, risk-on and risk-off periods.[10] Also shown are corresponding statistics for a portfolio with equal weights in bonds and equities, a levered and unlevered risk-parity portfolio, and the Sharpe ratio.[11]

The risk-parity portfolio is constructed as follows. At the end of each year from 2001 to 2012, the variance-covariance matrix is constructed based on weekly returns to equities and bonds in the preceding 12 months. From this matrix the contribution of bonds and equities to the standard deviation of the portfolio can be determined, assuming a weight w_1 for bonds and a weight of $w_2=1-w_1$, for equities.[12] An optimiser is then used to calculate the weights for bonds and equities such that they contribute equally to the riskiness of the portfolio. This optimisation determines the weights of bonds and equities in the risk-parity portfolio for the upcoming year.

The risk-parity portfolio tends to be significantly overweight in bonds relative to equities and has an average allocation to bonds of 81 per cent in our sample and a relatively low expected return. The use of leverage (often via derivatives contracts) can boost the expected return to this portfolio and we illustrate this using a mild leverage ratio of 20 per cent.

FIGURE 2: Cumulative risk-off risk-on indicator. The series below ('Cumulative_Risk_On') is calculated as follows: the series starts at zero and is either increased by one if a 'risk-on' period has been identified for the next period, or decreased by one if a 'risk-off' period has been identified for the next period, or remains unchanged if the next period is a non-RORO period.



The effect of the RORO paradigm is that diversification benefits are significantly diluted and equity-only or bond-only portfolios have significantly higher volatility.

Table 1 shows that over the full sample, the unlevered risk-parity and levered risk-parity portfolio have the highest Sharpe ratio. While the S&P/ASX 200 generates the highest excess return (excluding the levered risk-parity portfolio) it also has the lowest Sharpe ratio. The portfolio of Australian government bonds has a much higher Sharpe ratio compared to equities although still lower than that of the risk-parity portfolio. In non-RORO periods, these results continue to hold.

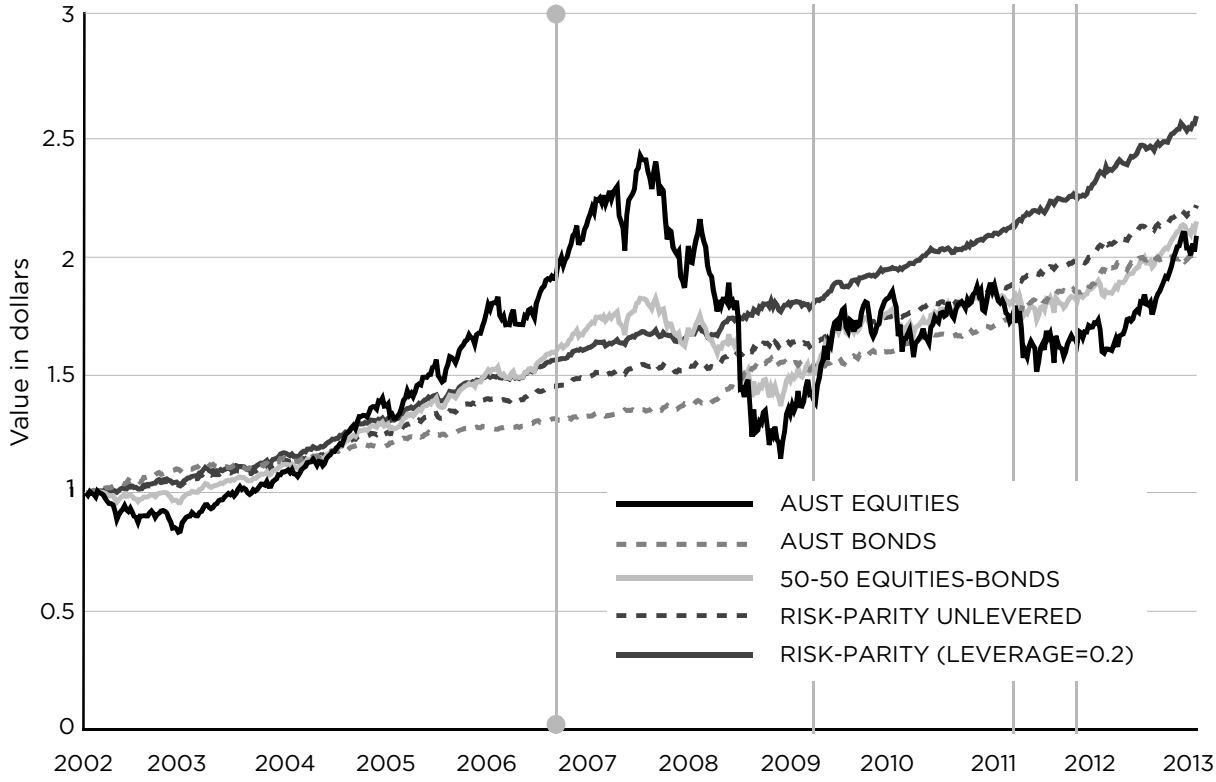
The table shows the annualised returns to various series, in percentages and annualised standard deviations. All series are downloaded from the Morningstar Database. *S&P/ASX200* is the ASX200 Accumulation Index. *ASX_GOV_BOND* is the Morningstar Australian Government Bond Index. *EQUAL WEIGHTED* is a portfolio that is an equally weighted combination of ASX200 and *ASX_GOV_BOND*. *UNLEVERED RISK-PARITY* is an unlevered risk-parity portfolio such that bonds and equities contribute equally to the riskiness of the portfolio. *LEVERED RISK-PARITY* is the same as the unlevered risk-parity portfolio but uses 20 per cent leverage to boost the expected returns to the portfolio. The risk-free rate used to compute the Sharpe ratio is the annualised yield on 90-day bank accepted bills.

Table 1 suggests that the risk-parity portfolio generates a respectable Sharpe ratio in all of the risk-on, risk-off and non-RORO periods. As one would expect, equities perform very well in risk-on periods (generating 84.7 per cent p.a.) but also very poorly in risk-off periods (losing 92.7 per cent p.a.). Bonds perform very well in risk-off periods (generating 19.65 per cent p.a.) and poorly in risk-on periods, but not too badly compared with the performance of equities in risk-off periods. Based on the sample period used, the results suggest that a risk-averse Australian investor should overweight their portfolio to bonds relative to equities in both RORO and non-RORO periods. This makes intuitive sense given the uncertain economic conditions around the world in the recent times that have coincided with RORO.

TABLE 1: Descriptive statistics for equity and bond indices, an equally weighted portfolio of equities and bonds, an unlevered and levered risk-parity portfolio for non-RORO and RORO periods

	ASX200	*ASX_GOV_BOND*	*EQUAL WEIGHTED*	*UNLEVERED RISK-PARITY*	*LEVERED RISK-PARITY*
FULL SAMPLE					
Mean	7.91	6.41	7.16	7.21	8.63
Std dev	16.30	2.94	7.75	2.82	3.38
Sharpe ratio	0.48	2.16	0.92	2.54	2.54
Non-RORO					
Mean	14.24	5.94	10.09	7.98	9.54
Std dev	11.74	2.70	5.78	2.84	3.40
Sharpe ratio	1.21	2.18	1.74	2.79	2.79
RORO					
Mean	-2.03	7.15	2.56	6.01	7.21
Std dev	21.56	3.29	10.08	2.79	3.35
Sharpe ratio	-0.10	2.16	0.25	2.14	2.14
Risk-on					
Mean	84.72	-4.81	39.95	6.44	7.76
Std dev	14.27	2.60	7.08	2.66	3.19
Sharpe ratio	5.93	-1.87	5.63	2.41	2.42
Risk-off					
Mean	-92.71	19.65	-36.53	5.55	6.63
Std dev	20.73	3.05	9.90	2.92	3.52
Sharpe ratio	-4.47	6.44	-3.69	1.88	1.87

FIGURE 3: The value of $1 invested in the S&P/ASX 200, a portfolio of Australian government bonds, an equally weighted combination of the S&P/ASX 200 and Australian government bonds and a levered and unlevered risk-parity portfolio (April 2002 to April 2013).



These facts are reflected in Figure 3, which shows the value of $1 invested in each of the five portfolios analysed here over the full sample period. The levered and unlevered risk-parity portfolios perform most strongly over this period.

The figure also shows the major risk-off and risk-on periods identified in Figure 2, that is, risk-off from February 2007 to June 2009, risk-on from June 2009 to April 2011 and risk-off from April 2011 to August 2011.

Conclusion

This study has highlighted the significance of the RORO paradigm in Australia. The effect of the RORO paradigm is that diversification benefits are significantly diluted and equity-only or bond-only portfolios have significantly higher volatility.

In a RORO world one technique that may help investors is to use a risk-parity approach which combines both bonds and equities so that both equities and bonds contribute equally to the riskiness of the portfolio. This approach almost invariably overweights bonds due to their lower volatility. Leverage may be used to boost returns if desired but this leads to other risk factors associated with taking on leverage. Another strategy could involve forecasting of risk-off and risk-on periods through analysis of macroeconomic variables such as the term structure of interest rates and the PE ratio of the stock market as a whole. ■

Notes

1. I would like to thank Kevin Davis and David Robinson for providing valuable comments on an earlier draft of this paper. Of course any errors in this manuscript are my own responsibility.
2. In this context, risky assets are such things as equities, commodities or speculative currencies and safe assets are bonds or safe-haven currencies suwch as the US dollar or Japanese yen.
3. As we have five bond indices, this means calculating a 5x5 correlation matrix based on the 52 weeks of data in our window and then averaging the 10 entries in the lower triangle of that matrix.
4. HSBC Global Research (2010, 2012) presents an augmented version of this methodology to determine risk-on and risk-off periods using data on exchange rates and commodities in addition to bonds and equities. In this study, all data is from Datastream and uses the weekly Total Return series for each equity or bond index. Data on the AFMA Australian Fixed Interest Index is used as a Total Return Index for 10-year Australian Government bonds was unavailable.
5. This methodology implies that for any point in our sample the determination of whether it is RORO or non-RORO is based on past, current and future data. This weakness can be overcome by comparing current intra-bond and intra-stock correlations with their average values based on past observations only.
6. This depiction of risk-off and risk-on matches fairly closely with the timelines presented in HSBC (2010).
7. See http://www.bbc.co.uk/news/business-15198789 and http://awadvisors.com/2013/02/11/the-effect-of-quantitative-easing/ for a discussion of the effect of QE in the UK and US, respectively.
8. See http://www.guardian.co.uk/business/interactive/2012/oct/17/eurozone-crisis-interactive-timeline-three-years for a summary of major worldwide financial events pertaining to the Eurozone crisis.
9. See for example Saft (2013) and Lefeuvre and Oberg (2013).
10. These annualised figures are obtained by multiplying the weekly average return and weekly standard deviation (both in per cent) by 52 and $\sqrt{52}$ respectively. The annualised Sharpe ratio is the weekly Sharpe ratio multiplied by $\sqrt{52}$.
11. The Sharpe ratio is used here to measure risk-adjusted returns. More formal methods for measuring risk-adjusted returns could include calculating alphas from a CAPM model or from the Fama and French (1993) and Carhart (1997) multi-factor models. Kazemi (2010) contains more details on risk-parity portfolios.
12. Assuming bonds have weight w_1 and variance s_1^2 and equities have weight w_2 and variance s_2^2 and the covariance between bonds and equities is $s_{1,2}$, the contribution of bonds to portfolio volatility is $\frac{w_1^2 s_1^2 + w_1 w_2 s_{1,2}}{s_p}$ and the contribution of equities to portfolio volatility is: $\frac{w_2^2 s_2^2 + w_1 w_2 s_{1,2}}{s_p}$ where $s_p = \sqrt{w_1^2 s_1^2 + 2 w_1 w_2 s_{1,2} + w_2^2 s_2^2}$ is portfolio volatility.

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